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WATER PIPES OF WOOD
SUCCEEDING IN SAFETY ENGINEERING

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

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NEW YORK'S SKY-LINE ARTISANS: STRUCTURAL-IRON WORKERS

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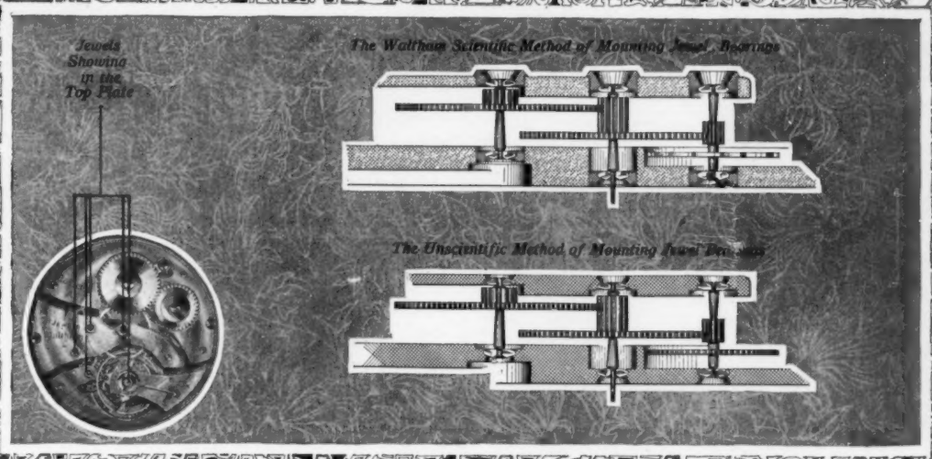
Jewels Showing in the Top Plate
The Waltham Scientific Method of Mounting Jewel Bearings
The Unscientific Method of Mounting Jewel Bearings

THE MOST SCIENTIFICALLY BUILT WATCH IN THE WORLD

The Waltham Scientific Method of Mounting Jewel Bearings that is so Important in Your Watch

THE bearings of a watch are jewels because a precious stone is the hardest known substance for use in this important function. The harder the material and the smoother its polish the less resultant friction.

The chief problem confronting the old-time watchmaker when he first conceived the idea of using precious stones was a correct method to secure properly the jewels in the plates of the watch.

To do this, he cut a seat in the watch plate, then with a sharp tool forced the metal over the edge of the jewel.

So important was the necessity of securing the jewels rigidly in relation to their bearings (with the pivot hole exactly in the center and the jewel in perfect alignment with the plate and pivot so that the jewels could be removed easily for cleaning or repairing when injured) the Waltham Watch Company, after years of painstaking development, created a scientific method of jewel setting which made it easy for the jewels to be so removed and reset without affecting in any way the original time-keeping quality of the watch.

This scientific Waltham Method secures the jewel in a separate brass or gold setting. This setting is cut to a diameter to fit perfectly its aperture in the plate, then pressed to its correct position in relation to the pivots (or axle) completing the jeweled bearing.

The special tools invented by Waltham so expand the jewel setting in its aperture that it becomes rigidly located. This eliminates the method of using holding-screws and greatly simplifies the work of the watch repairer whenever it is necessary to replace a jewel bearing.

The Waltham Scientific Method of mounting jewel bearings is a distinctive and better way of securing the jewels in the setting, and also of the setting in the plate. It provides the easiest and safest way for the repairer to handle your watch. It protects the original time-keeping quality of the watch. It reduces up-keep and insures a continuous satisfaction because of dependable time-keeping service.

This is one more reason, in addition to many others of like value, why your watch selection should be a Waltham.

Waltham Colonial A
Extremely thin at no sacrifice of accuracy
Maximus movement 21 jewels
Riverside movement 19 jewels
$200 to $325 or more
depending upon the case

This story is continued in a beautiful booklet in which you will find a liberal watch education. Sent free upon request. Waltham Watch Company, Waltham, Mass.

WALTHAM

THE WORLD'S WATCH OVER TIME

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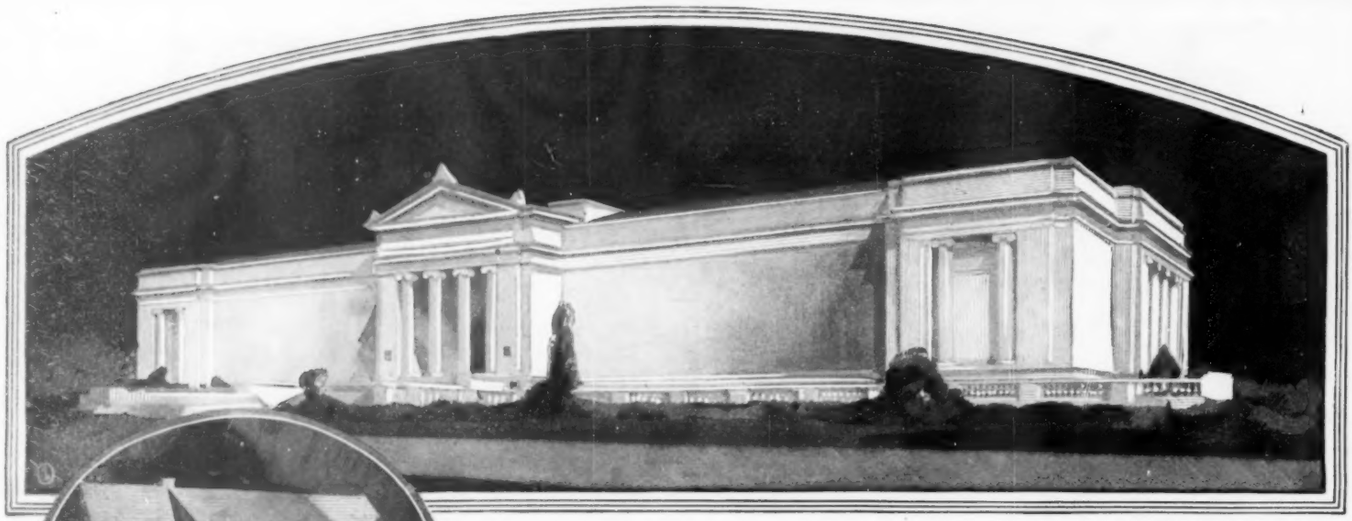

Cleveland Museum of Art, Wade Park, Cleveland, Ohio. Hubbell & Benes, Architects
Covered with Johns-Manville Asbestos Built-Up Roofing.

Residence of Mr. G. Schrader, Pasadena, California. Roofed with Johns-Manville Asbestos Shingles.

Both these buildings have one virtue in common—an Asbestos Roof

FOR this great public museum the architect sought the best roofing.

For the modest dwelling the owner sought the most *economical*. Both chose Johns-Manville Asbestos Roofing.

But you may say, "How can *the best*—inferring quality and high cost—be also economical?"

The answer to this lies at the very base of the reason for Asbestos in roofing form.

The vision that 25 years ago saw in Asbestos the future roofing material, had but two factors in mind—long life (without upkeep cost)—and safety from fire.

These are the properties of Asbestos, translated into an ideal roofing specification.

In considering Asbestos as your roofing, remember the keenest calculators of building costs and building-up-keep have adopted it as standard and not because of the novel fact that it is the only all-mineral roofing felt or slab, but because of its positive immunity from rot, drying out or decomposition, which mean constant roof attention and repair. It is as inert to the weathering elements as it is from fire—not only lasting but fire safe; a new standard for a roofing to meet.

In the list below you will find a Johns-Manville Asbestos Roofing for the particular type of building you have in mind.

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Asbestos Ready-to-Lay Roofing, Standard and Colorblende Asbestos Shingles, Corrugated Asbestos Roofing, Built-Up Asbestos Roofing.

Johns-Manville Asbestos Roofings are approved by the Underwriters' Laboratories, Inc.

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and so have these

Saw-tooth roof covered with Johns-Manville Asbestos Ready Roofing.

Monitor type roof covered with Johns-Manville Asbestos Ready Roofing.

Grain elevator covered with Johns-Manville Asbestos Roofing and Asbestoside.

ROOFING—Blasted from Rock!
Many who actually examine Johns-Manville Asbestos Roofing for the first time, find it hard to realize that this pliable sheet is really stone, blasted from the ground like marble or granite. And Asbestos felt is the only all-mineral roofing felt.

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Through—

Asbestos
and its allied products

INSULATION
that keeps the heat where it belongs
CEMENTS
that make boiler walls leak-proof
ROOFINGS
that cut down fire risks
PACKINGS
that save power waste
LININGS
that make brakes safe
FIRE PREVENTION PRODUCTS

JOHNS MANVILLE
Serves in Conservation

SEVENTY-SIXTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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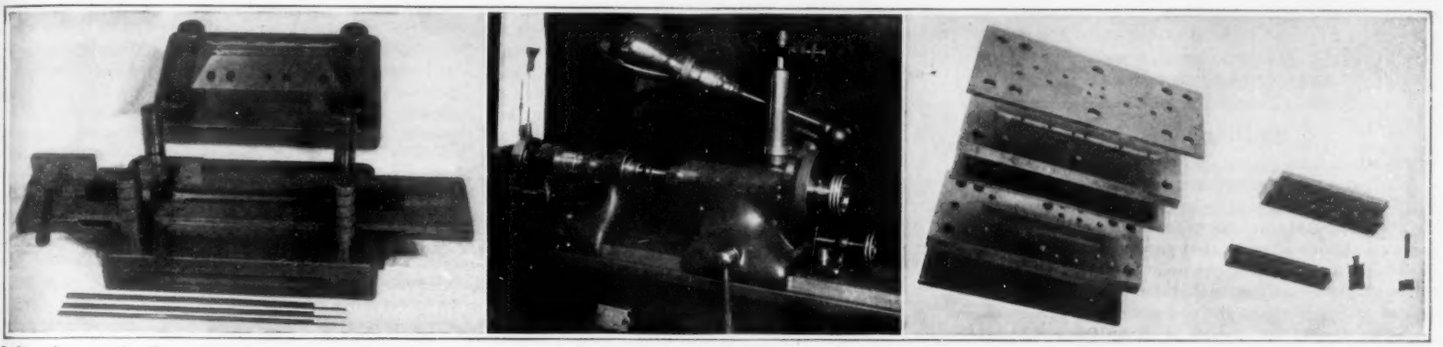


Left: An exceptionally accurate perforating punch-and-die used in turning out high-grade electrical apparatus. *Center:* A rather unusual assembly of an ordinary micrometer and a liquid gage that multiplies its measurements by more than a thousand. *Right:* The punch-and-die machine taken apart to show its internal construction.

Some of the tools that are used to translate the hundred-thousandth of an inch into practice

Splitting Hairs With Close-Limit Tools

By Alfred Longville

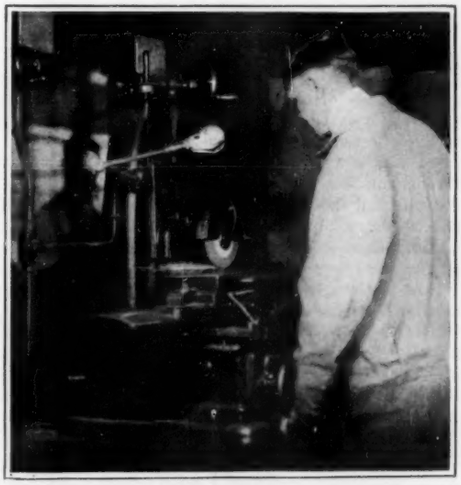
WHEN is an inch not an inch? The question is not a brand new conundrum; it is asked in all seriousness. One would answer correctly by saying that 999 one-thousandths of an inch is not an inch. To the layman such a trifle as a ten-thousandth of an inch might not be of much moment. But in the making of tools which turn out certain electrical apparatus an inch isn't exactly an inch if it's even a hundredth of a hair too long or short.

What does the average person visualize by the term a ten-thousandth part of an inch? Said person might smile and say there is no such thing. It would not be missed off the end of a yardstick, might be the contention. Yet as certain as little drops of water go towards the making of an ocean, so would an inch disappear entirely if one continued to chop ten-thousandth parts of it away. The same would be true if one were to divide the ten-thousandth part by ten and make it a one hundred-thousandth part of an inch. To most minds an inch is small enough and any smaller dimension is hardly to be reckoned with. Yet as small as it is, if it were possible to slice an inch into one hundred thousand parts and slice off each part as rapidly as one can deal playing cards from off a deck, which is about four to a second, six hours, fifty-six minutes, and forty seconds would elapse before the last one hundred-thousandth of an inch was sliced off.

In order that one may get a better idea of a hundred-thousandth part of an inch, or even a ten-thousandth part of an inch, let one place one's imagination to the eye-piece of a compound microscope, under which there is a filament of some substance a ten-thousandth of an inch in diameter, side by side with a human hair of average size. Seen through the ordinary microscope, the hair would look about the size of a lead pencil. Yet the ten-thousandth of an inch filament, magnified to the same extent, would appear about as thick as the human hair.

If one by this time is able to imagine a tenth of what is left of that ten-thousandth part, after it is taken away from the microscope and does not appear magnified, one may begin to understand something about close-limit tools, one of which is a punch and die for perforating used to turn out certain electrical apparatus. This particular tool is composed of a certain number of similar sections, so nearly alike that their thickness does not differ as much as one thousandth part of an inch. And if one by this time has been able to imagine just what this minute measurement constitutes, one is no doubt awaiting with an amazed expression to learn just how any one can possibly determine whether an inch is exactly an inch or only 999 one-thousandth parts of an inch.

The ways of telling are diverse and interesting. When a tool-maker is at work on a given block he generally uses what he calls an "indicator gage." This gage consists of a flat disk on which the measured piece is placed, and a small cylindrical upper jaw, movable in a vertical direction. This upper jaw connects through a series of levers to a pointer, which moves over a scale. Owing to the leverage, this pointer moves about one-sixteenth of an inch for every ten-thousandth of an inch movement of the upper jaw. Therefore, with the upper jaw so set that the pointer will rest on the zero line when the standard adjusting block is in the gage, a practical tool-maker can compare another block with the standard without getting much over a hundred-thousandth of an inch error. To make sure of that hundred-thousandth the blocks are checked in a measuring machine in which the indicating jaw is connected to a liquid gage that multiplies 1,300 to one. This gage is simply a relatively large cylindrical chamber with a small-bore glass tube projecting from the top. The front of this chamber is closed by a flexible diaphragm, against which the far end of the indicating jaw rests. When this jaw is opened a small amount it pushes the diaphragm a little way into the chamber. Now, if the chamber is entirely filled with a liquid, this movement of the diaphragm will displace some of the liquid and force it up the small glass tube. Since a very small quantity of liquid goes a long way in a very small diameter tube, it is easy to see how such a gage can multiply the movement of the indicator jaw 1,300 times.



A grinding machine that produces work accurately within the twenty-thousandth of an inch

Comparing two lengths within a hundred-thousandth of an inch is no trick at all on this machine. But so little cannot be said of *getting* them to within a hundred-thousandth of an inch. The later stage comprises a series of tricks, to master all of which the most skilled tool workers would be hard put in a single life time. Because of this fact the tool-makers are specializing in their work.

Various operations, such as milling, lathe work, grinding, fitting, etc., are done by different groups in which men exceptionally good at one branch of their specialized sub-work keep at that sort of work exclusively. Because of this kind of specialization it is possible to build a tool as large as the perforating punch and die and at the same time get it within the degree of accuracy required. It would be possible to do so without this specialization, but the cost and the length of time involved in the completion of such a tool would be prohibitive by the methods used in most tool-making establishments. Outside tool-makers who have not specialized in this work declare that it is practically a commercial impossibility to make such a tool.

The commutator-strip perforating punch-and-die is built up of 50 punch sections, 50 die sections, and 50 shedder sections. Each punch section is exactly like every other punch section, each die section exactly like every other die section, and each shedder section exactly like every other shedder section, granting that one-hundred-thousandth of an inch is close enough to signify exactness.

The method by which the tool-maker makes them that way is peculiarly interesting. At first the parts are machined and ground to what the most exact person would term a high degree of accuracy. After this they are hardened, during which process a certain amount of distortion always occurs, following which they are submitted to the real job of being ground. They are ground to within five one-hundred-thousandths of the standard size, which constitutes a real job in grinding. It requires the very best of machines and the very best of operators, familiar with all of the idiosyncracies of their machines, to produce work of such accuracy. This job is better appreciated when

(Continued on page 260)

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Shifting Lines

THE definite profession of the engineer is of comparatively recent origin. There have, of course, always been men under whose eyes the work of the world has been done. The Roman highways, the bridge of boats that gave the Persian access to Europe, the pyramids, the great works of the Mesopotamian plain—all these called for what we recognize as engineering instincts and abilities in the conception, the planning and the execution. Even the early arts, like bow-making and pottery and boat construction, are examples of primitive engineering skill—the making of anything that comes out as it was intended to come out and that serves the purpose for which it was planned is engineering work. But throughout the prehistoric, ancient and medieval periods and well into the modern, the engineer was merely the boss artisan.

With the widening of human knowledge since, say, 1800, the effort to keep this corpus in order and to apply it to concrete cases as they arise has demanded a special profession. To meet this demand the engineer was created—or created himself; and he has been in existence long enough for us to get something of the historical viewpoint toward him. Various aspects of this viewpoint might be emphasized; the one that inspires these remarks has to do with the manner in which the vast field of the engineer was, and the manner in which it now is, subdivided. There has been here a significant shifting of lines.

Originally we had the civil and the mechanical and the electrical engineer. From the day when the engineer was first called on for evidences of specialization within his field, he followed one of these three directions. The first-named would apply his knowledge with equal facility to the laying out of a railroad or the surveying of a new country or the erection of a great bridge or the designing of a floor to carry a heavy load or the throwing of a dam across a stream or the location of the best highway between two given points. The second found it a matter of indifference what sort of a factory he was sent to, or what manner of machinery he was asked to install or maintain there. And the last-named was quite prepared to work in telegraphy today, in dynamos tomorrow, in street-car motors or trolley wires the next day, and in electrolysis next week. The engineering field was divided according to the raw materials of the engineer, and, so divided, it fell naturally into the three domains outlined—that of the engineer whose raw material is electricity, that of the one who does things with machines, and that of him who works with the static forces of the visible external world.

In the beginning of the profession this was altogether satisfactory. It has not remained so. The first sign of a break in the old scheme came early, with the segregation of the mining engineer as a distinct sort of animal. To qualify for this profession a man had to have some of the equipment of each of the three preexisting groups, but in none of these fields did he require complete training. The reason for building up this composite of the three existing branches and giving it a name and a standing of its own was the very excellent one that mining work called for all three types of service, yet made demands which it seemed should be possible for one man to meet. So the man arose to meet them, embodying in his own equipment the elements of the necessary coöperation between civil, electrical and mechanical engineering, making his own such parts of these three fields as he needed in his business and discarding the rest.

Eventually the process was repeated, not in one but in many instances. What it then came to was the regrouping of the engineers on a new basis. It would mean nothing today to claim to be a civil or a mechanical or an electrical engineer—it would give not the least information as to what the claimant was qualified for and what he was not. For today we have railroad-signal engineers and automotive engineers and safety engineers and marine engineers and turbine engineers and dock engineers and conveyor-belt engineers and magneto engineers and highway engineers and subway engineers—and a host of others which we have neither the time nor the space nor the patience to catalog. Each of these professions is distinguished from the others, not so much in what the incumbent has by way of technical equipment as in what he does with it. So the old division on a basis of raw materials has passed away, and today we catalog our engineers according to their finished products.

This is eminently sensible and eminently modern in viewpoint. Three thousand years ago it was natural and proper to group workers according to the material in which they worked. In those simple days a man was a mason or a carpenter or a weaver or an ironsmith or a coppersmith or silver-and-gold smith. At that date it would have been ridiculous to group the mason and the tent-maker together on the mere ground that both were engaged in the construction of human habitations. But with the multiplication of tools and of knowledge, it would be just as absurd to catalog a manufacturer of telephone wire and a photo-engraver in the same group on the mere ground that they both use copper as a raw material. We prefer to regard the wire maker as an industrial brother of the battery builder and the man who makes composition stands and mouthpieces, while we relate the photo-engraver with the compositor and the pressman—substituting a classification that follows the finished product for the one that follows the raw materials employed. So it is in the engineering field, and properly. Civilization weaves so complex a web of causes that we find it far easier to distinguish and identify results.

When the Grim Specter Stalks

PLAGUES, we ordinarily think, are a thing of the past. Now and then we have isolated cases, even local epidemics on a small scale, of smallpox and the bubonic plage. But with the word "plague" we associate a phenomenon that is distinctly obsolete—the utter ravaging of whole countries and continents by a pandemic that is swift in its spread and high in its percentage of mortality.

The reason for this is of course that we know more than our ancestors did. Yet with all our knowledge, we are not free from plagues that, considering our improved ability to meet them, make away with a disgracefully large proportion of our numbers. The great plagues of history have been to all intents and purposes stamped out, and our success in achieving this end is attributable to the fact that every one of these plagues, with one exception, was transmitted through an intermediary agent. We can exterminate the rats and the mosquitoes, we can regulate the milk and water supply, by a simple exercise of the police power. Even in the case of smallpox, there is the almost certain prevention through the single, simple act of vaccination; and this, too, can be enforced through exercise of the police power.

But the plagues of today—the minor ones, such as scarlet fever, whooping cough and measles, or the major ones, such as influenza, pneumonia and tuberculosis—are transmitted in quite a different fashion, and require for their ultimate stamping out measures of quite a different character. They are independent of intermediate hosts and to a great extent of food and drink pollution. Their eradication depends not alone upon compulsory isolation of reported cases, but upon personal habits as well. Transmission is strictly through personal contact. Many of these maladies are transmitted during their early stages, before a diagnosis is possible and hence before specific protection against the individual carrier can be effected.

So where originally the health officer required merely the qualifications of a policeman, he must now add to these the training of an engineer and the abilities of an educator. The combination is doubtless a rare one; but to prevent the spread of disease all three of these functions must operate. The finger which goes to the nose and then to the doorknob must be restrained; the unguarded sneeze or cough in the public place must be made to yield to education. The offender must learn that he is restrained, not necessarily because of any belief that he is actually spreading disease—to the person of average good habits there is something particularly insulting about this suggestion, even when he realizes that he necessarily carries with him at all times a choice collection of the germs of all the standard diseases, which only await the opportunity to become active—but merely in the execution of a general policy. Even if we believe that a particular member of the community has no germs to spread, we cannot permit him to do things that are forbidden to those who may have such germs—we might as well allow respectable citizens to jimmy their way into locked houses just for the fun of so doing, and punish only those wielders of the burglarious tool whose intent can be proved felonious. The public at large must be educated to an understanding of the fact that its protection requires certain rules to be laid down for observance by everyone, without exception. When this viewpoint is general, and when the people at large have so thorough an understanding of health protection that adequate moral and financial support will be extended to the health administration, we may find that tuberculosis and influenza and pneumonia and scarlet fever are no more necessary concomitants of community life than were bubonic and typhoid.

Greek Kakophony in the English Language

IT has been remarked that practically everything worth while in our modern civilization can be traced back to the influence of Greek antiquity. Far be it from us to say anything derogatory of our debt to the sages and poets of Hellas. But it is human to feel our little itching discomforts more than the solid blessings of life. So we cannot help wishing, sometimes, that our Greek heritage had come down to us without collecting an irksome tax; without inoculating upon our good old English tongue the germs of such philogical antics, as for example, *poikilotherm, enantiomorph, schizophrenia, epistemology,*—and, horror of horrors, such words as *syzygy* and *phthisis.*

Presumably we may charge this influx of uncouth aliens into our technical terminology, in the first instance, against the early classical scholars, who set the fashion since followed. Whether we owe them a debt of gratitude for this may be left undiscussed. But when we reflect upon the offense to tongue and ear which these verbal monstrosities commit, we are set wondering whether the lover of the dead languages has quite as fine an ear for euphony as he, no doubt, would have us believe. Perhaps enthusiasm has clouded better judgment. We recall, in that dim past when we were gracing the school bench with our (then) juvenile presence, how our revered classical master, one afternoon, held forth to us about the beauties of the Greek language. His remarks were pointed with a reading from Homer, which he rendered with fine fervor; totally oblivious of the fact that, had he been addressing a Greek audience he might, indeed, have made a lively impression upon their sense of humor, but certainly could have made little appeal to any other faculty. For scarcely a word would they have understood of the gibberish into which their words were distorted by his English pronunciation.

There they are now, firmly rooted in our native tongue, those words of foreign sound; refusing to fall into the natural cadence of our speech; shuffling along in the procession of our discourse as the limping, the lame and the halt in a gay parade. Uncouth, incongruous, they stand out against the sober background of language like the offending patch in the seat of a boy's breeches.

Electricity

Electric Hatching of Chicks.—A third of a million chickens a season is the proposed capacity which a customer of the Electric Power Company of Portland, Ore., intends to attain in his electrically-operated chicken farm known as "Henacres." His output this season will be in the neighborhood of 100,000 chickens, as compared with 45,000 for last year. This farm started with one small electric incubator in 1915 and now is equipped to operate on a large scale, having a single incubator with a capacity of 20,000 eggs. The total connected load for this plant consists of 33.5 kilowatts of heating and 3 kilowatts of lighting. For emergency service, continues *Electrical Review*, a 20-kilowatt direct current generator is installed at the farm and is so arranged that it may be driven from the owner's truck.

Britain's Wireless Chain.—The long-contemplated plan to connect all parts of the British Empire by wireless telegraph has received fresh impetus through the issue of a report of the committee appointed by the Government to formulate such a scheme. The committee's report, which is unanimous, recommends that the Empire shall be linked up wirelessly by stages of about 2,000 miles each and that the system employed shall be that of the generation of radio-telegraphic energy by vacuum tubes. The scheme contemplates two main chains of wireless, one receiving dispatches from Africa and the other from Asia and Australasia, both with Cairo as their first station. For the first link of the first chain a connection would be made on the Poulsen arc system between Oxford and Cairo, which the Post Office Department has nearly completed.

Electric Purification of Air.—In a recent *Comptes Rendus* there appears an interesting account of experiments conducted by D'Arsonval, Bordas and Touplain of France, on the electric purification of air. A simple apparatus was used for this purpose, namely, a brass tube 1 meter long with an axial wire, air being passed through the tube at the rate of 127 cu. m. (4,500 cu. ft.) an hour. The air was purposely polluted with a fine sterile mineral powder and also with dried cultures of a certain microbe. After passing through the tube, the central wire being maintained at a negative potential of 50,000 volts, the air was found to be absolutely sterile, while 95 to 97 per cent of the powder was removed. Before passing the tube samples of air gave 150 cultures of the microbe per cubic meter. It is suggested that the ozonization may have aided in destroying the microbes.

A Vacuum Tube Transmitter.—In order to utilize a radio-frequency wave train of given power most effectively in a non-oscillating receiving system it must be completely modulated at some suitable audio frequency. A convenient way of accomplishing this modulation, when an electron tube generator is used, is by supplying the plate circuit of the tube or tubes with an audio-frequency alternating current. An alternator may be used with suitable transformers to supply both the filament and plate circuits. A self-contained transmitting set of this type has been designed and built at the Bureau of Standards, Washington, D. C. A description of the set, with photograph and diagrams, is given in the Bureau's Scientific Paper No. 381, entitled "An Electron Tube Transmitter of Completely Modulated Waves." Overall efficiency as high as 35 per cent is obtained with the set.

Durability of Electric Heaters for Distillation of gasoline is covered in one of the recent reports of the Bureau of Mines. An electric gasoline distillation heater and a commercial device sold for the same use have been subjected to life tests at a maximum current load. Each failed at the end of approximately 500 hours, the bureau heater through deterioration of the resistance wire and the commercial heater through disintegration of the block of insulating material holding the resistance wire. The bureau heater has an inverted conical resistance element surrounded by a layer of heat-insulating material and mounted in a metal case having a top of hard asbestos board. The resistance element is a helix of nickel-chromium alloy wire held by a molded core of alundum. The commercial heater has a helix of nickel-chromium alloy wire resting in a spiral groove cut in a depression in a block of heat-insulating composition. The coils of wire are held in place by a special cross of sheet mica.

Science

The Centenary of Sir Joseph Banks, who died June 17, 1820, was commemorated June 17 of this year by the Linnean Society, in London, with a program of papers relating to Banks and his work and an exhibition of objects connected with his life. One of the papers presented was, the author stated, based on the daily use of specimens from Bank's herbarium, now in the British Museum. Sir Joseph Banks, Bart., was president of the Royal Society for 42 years.

A New Journal of Genetics, known as *Hereditas,* has just been started by the Mendelian Society of Lund, Sweden, the president of which is Prof. H. Nilsson-Ehle, well known for his breeding experiments with wheat. The journal will be published about three times annually, and will contain papers in English, French and German. It will deal with problems of man as well as of plants and animals. The subscription price is 25 Swedish crowns per volume.

Protection of Alaskan Animals.—In accordance with a recent Act of Congress, the duty of protecting land fur-bearing animals in Alaska, formerly entrusted to the Department of Commerce, was transferred July 1 to the Department of Agriculture and has been assigned to the Biological Survey of the latter department. The Secretary of Agriculture has issued regulations conforming generally to those previously in force with regard to the hunting of the animals in question, shipment of furs, etc.

A Student of Ball Lightning. The Reverend Ignazio Galli, ex-director of the observatory of Velletri, who died February 1 of this year, at the age of 79, was one of the most interesting personalities in the scientific world of Italy. We had occasion, a few years ago, to refer editorially to Galli's keen interest in the project of reviving Latin as the international language of science. He has been a versatile writer on scientific topics, but has been especially prominent in recent years as a collector of information concerning the still enigmatical phenomenon of ball lightning on which he has published a long series of papers.

International Geodetic and Geophysical Union.—National unions affiliated with this international body have been organized in Great Britain, Japan, France, Canada and the United States. Each national union has its subdivisions, representing individual sciences. The American Geophysical Union, permanently organized this year under the auspices of the National Research Council, elected officers April 23. Mr. Wm. Bowie of the Coast and Geodetic Survey is chairman, Dr. L. A. Bauer of the Carnegie Department of Terrestrial Magnetism, vice-chairman, and Dr. Harry O. Wood, secretary. A new section devoted to geophysical chemistry has been added to this body.

The Meyer Memorial Medal.—When the well-known agricultural explorer, Frank N. Meyer, lost his life in the Yangtze River, in 1918, he left a bequest of a thousand dollars to the staff of the U. S. Office of Foreign Seed and Plant Introduction. The recipients of this bequest have put the money into a permanent tribute to Meyer's memory in the shape of a medal to be awarded for distinguished service in plant introduction. The awards are to be made by the council of the American Genetic Association. The medal was awarded for the first time on May 3, 1920, the medalist being Mr. Barbour Lathrop, one of the founders of the plant and seed introduction work of the United States Government.

Long-range Weather Prophets.—The erudite and versatile director of the Prussian Meteorological institute, Dr. Gustav Hellman, has recently issued a second series of contributions to the history of meteorology, one paper of which deals at length with the non-scientific long-range weather forecasters of the 19th and present centuries. The popular celebrity acquired by many of these persons is a remarkable example of human gullibility. Although we miss the names of some recent American weather seers of wide reputation, Dr. Hellman's list is impressively long. He gives detailed accounts of the activities and publications of 105 long-range forecasters, distributed as to nationality as follows: Belgium, 2; Germany, 36; England, 25; France, 14; Italy, 2; Austria-Hungary, 8; Russia, 1; Sweden, 1; Switzerland, 5; Spain, 2; North America, 9.

Aeronautics

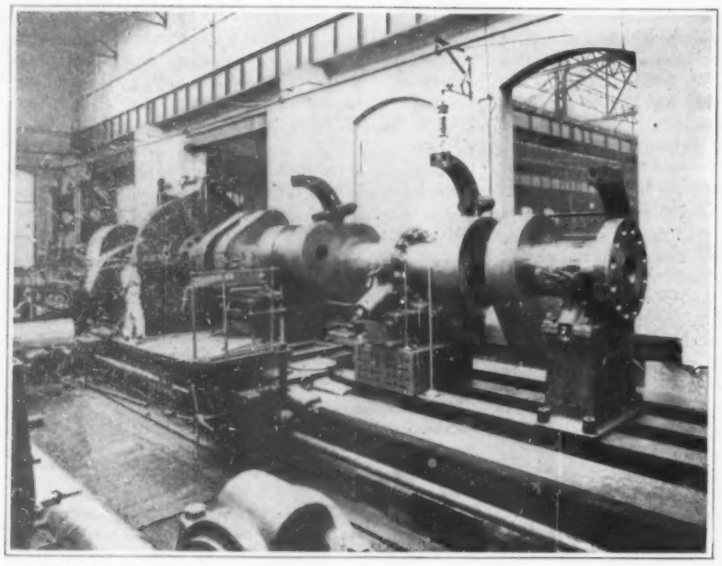
Army Airplanes Have Reached Alaska after a flight from Mitchel Field, Long Island. Four machines started on this long journey and every one finished. They came to ground on the flats of the Stikine River, some seven miles from Ketchikan, Alaska.

Clear View in Bad Weather is the object of a special screen devised by an Englishman, George Kent, and now being used extensively on the most up-to-date British planes. The clear vision screen is simply a disk of glass driven at a high rate of speed either by a small propeller carried on one of the struts, or by vanes fixed around the periphery of the disk. The disk, half of which is exposed, comprises the entire windshield. It maintains clear look-out in spite of rain or snow, or even oil thrown from the engine or tractor.

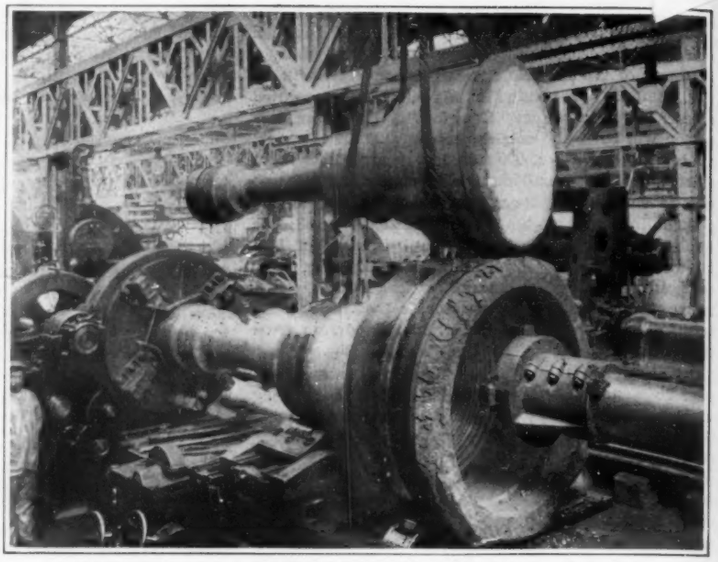
An Auxiliary Starting Battery.—In order to conserve the storage batteries which are a part of the equipment of the Curtiss Seagull three-seater flying boat, the Curtiss Flying Station at Atlantic City, N. J., has devised an ingenious device which has materially cut down costs and energy. The station fleet of flying boats is kept busy in passenger carrying. Between each flight ranging from 15 to 25 minutes, the motor is stopped necessitating considerable wear of the battery which is used on the self-starter. To eliminate the cost and bother of recharging the batteries, this flying station has introduced a small hand-car or "baby carriage" which carries the largest sized regular storage battery made. To start the motor of a flying boat, the "baby carriage" is wheeled up alongside and proper connections made. Thus the small storage battery aboard the seaplane is reserved for emergency purposes.

The "Joy-Stick" Patent Claims.—The war served to make us forget, at least temporarily, the matter of aeronautical patents. But with the excitement and rush of wartime aeronautical construction at last subsided, the various patent suits which have been hanging fire all these years are again coming into action. Thus French and British aircraft constructors are no doubt losing considerable sleep over the claims of M. Robert Esnault-Pelterie, who in 1907 patented the single lever for operating both longitudinal and lateral controls. Some time before the outbreak of the war in 1914 he instituted proceedings against various firms of airplane constructors, which, however, were interrupted by the outbreak of hostilities. In 1918 this inventor and aviation pioneer reopened his action against alleged infringers of the patent in question, claiming a sum of 2,000 francs in respect to each machine fitted with the device. It is estimated that the total sum involved is something over 50 millions of francs.

Should We Import Foreign Planes?—There is considerable feeling amongst American aircraft manufacturers concerning the importation of British and French machines into this country. The disposal boards of these countries have resold at a low cost to various firms the machines due under contract. Hundreds of these aircraft were never used owing to the armistice. Now these machines are being sent over here and are put on the market at a figure with which the American manufacturer is at present unable to compete. On the face of it, competition of this class is scarcely fair. It is true, of course, that the majority of the Americans who flew in France used British and French machines for the good reason that there were almost none of American make there before the armistice. There is no doubt that the boys got to know and to like the foreign makes, and there will be a natural tendency for them to buy the types whose record they know and which they know how to handle, particularly at a lower price than the entirely American machine can be turned out. The American aircraft industry has still a lot to learn from foreign technique, however, and the introduction of these aircraft should stimulate them to increased production. To prevent foreign entries by legislation is merely to hamper the advance of aviation and to put this country far behind Europe in the development of the science. If there were no demand for foreign machines there would be no supply.



Machining a huge crankshaft for marine use in the factory that used to make Austria's guns



Forming the end of a large shaft in the part of the works once given over to munitions making

Turning the Skoda Works from Swords to Plowshares

How the Austrian Krupp's, Under Czecho-Slovak Auspices, Is Producing Munitions of Peace

By Arthur J. Herschmann and Carl Scheid

AMERICANS are apt to form a wrong idea of what the new republic of Czecho-Slovakia comprises and what it is. The population is about 12 million and the territory about 130,000 square kilometers. Composed for the most part of the old kingdom of Bohemia with its wealth in gold, silver, iron, lignite, coal, graphite and radium, its chief adjunct is Moravia, which country is a very large agricultural and industrial factor. The railroads of the new republic measure about 6,000 miles and there are some 200,000 men employed in the iron industry of the country. During 1917 the production of the iron industry was 17 million hundredweight and there were imported from Sweden 10 million hundredweight of iron ore, quartz, coke and coal from Germany, besides limestone from Poland, and ferromanganese from Jugo-Slavia.

Great and significant changes are going on in the industries of Continental Europe and while we Americans are looking on, the other big nations are taking an active part and are becoming connected with the leading enterprises of the new republics. English and Italian interests have bought into Austrian steelworks and engineering plants, and chief among the French investments we will here concern ourselves with the famous Skoda Works which are now controlled by Schneider of Crusot.

Emil von Skoda took these works over in 1869 when they employed but 150 men on engineering work of a general nature. Today these works have a capital of $29,000,000 and an area of 1,325 acres of which 100 acres are built upon. There are over 7,000 machines and the horse-power generated within the works is 43,500. There have been as many as 3,000 clerks and office employes and over 33,000 men at work in the shops. The Skoda Works own their coal and iron mines and are equipped in the most thoroughly modern way. Together with their subsidiary plants they are self-sufficient and can produce almost anything that is made out of metal.

The headquarters are at Prague; the technical offices as well as the administrative departments are at Pilsen, Bohemia, where the works are located, west of Prague. Here are 9 Siemens-Martin furnaces equipped with most modern charging devices and operated in part as basic and in part as acid furnaces; they have a combined capacity of 300 tons and steel castings up to 100 tons in weight can be turned out of any quality and finished or in the rough. This department has supplied rudderposts, propellers, foundation plates, crankshafts and the like for the best known passenger vessels and warships of many European and Asiatic nations. Skoda Works make the softest dynamo steel of highest magnetic quality as well as the hardest steel for stone crushers, cement mills, and the steel department also produces flywheels over 60 tons in weight, wheels for water turbines, frames for rolling mills, anvils, railroad material of cast steel, etc. There is a special ingot foundry to serve the forges and rolling mills. Here large blocks are put under high pressure after the "Harmet" process and alloys are produced, free from blowholes, up to 105 tons in weight.

The foundry has 22 electric traveling cranes and 7 hydraulic jib cranes from 10 to 80 tons capacity, 7 large drying ovens besides large numbers of molding machines and a plant for the preparing of the sand.

Then spacious tempering ovens serve to treat the castings after they have been cleaned with compressed air tools, sandblast and cleaning machines of various kind. There are 2 magnetic traveling cranes with a span of 135 feet and a lifting capacity of 6 tons. The foundry has its own machine shop of over 12,000 square yards floor space, 11 electric cranes and among the tools is one which will turn pieces measuring 35 feet in diameter with great accuracy.

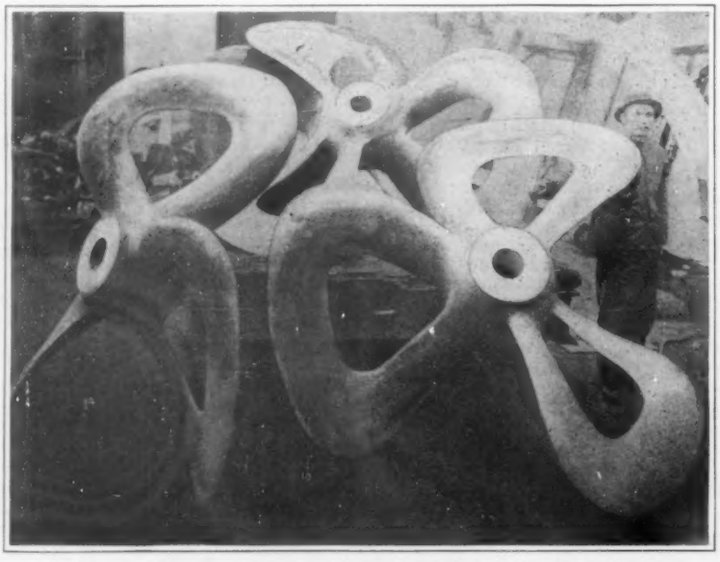
Here are steel furnaces of 4- and 6-ton capacity for thin quality castings of electric steel and 5 converter steel furnaces of 2 tons each. The iron foundry has several cupolas with Dutch ovens of an hourly capacity of 45,000 pounds, and there is a gas-fired furnace for the melting of quality iron which has a capacity of 10 tons. This department also contains 8 electric travelers from 3 to 60 tons capacity.

The metal foundry has 17 furnaces and produces castings up to 11,000 pounds in weight. Every kind of bronze is made, forged or cast, and the manufacture of aluminum castings of special alloy for automotive purposes and internal combustion engines is made a feature of production. The pattern-making shop covers 7,000 square yards and contains up-to-date American wood-working machinery.

The blacksmithing branch of manufacture is maintained in 7 halls of 22,000 square yards and has 9 steam-hydraulic presses, the largest of 5,000 tons pressure, several large steam hammers, hydraulic crowning presses, several rolling mills for tire material for car wheels, locomotive and tender tires. This section commands over 60 electrically-driven machines of modern construction, including lathes of 12 feet swing and 90 feet between the points, vertical boring mills of 18 feet diameter of the work, and shapers of 6 feet stroke. Tools to finish crankshafts are here of an accuracy of 2/100 of one millimeter. Boring mills of this department can handle tubes of almost 100 feet of length.

Thirty heating furnaces serve to treat the ingots with thermo-electric devices. For transportation and for the forges 35 electric traveling cranes are installed of a capacity of from 10 to 60 tons. Forgings are made up to 180,000 pounds for marine purposes, shafts up to 90 feet in length (see illustration), piston rods, connecting rods, rotors for turbines, and rolling stock of every conceivable kind. In the small forge are 17 steam hammers from 50 to 1,500 tons in capacity and 63 fires, 15 cranes from 3 to 5 tons capacity besides 2 main gantry cranes. Pieces are forged up to 5,500 pounds in weight.

A building of 10,000 square yards houses the spindle press plant and contains



A novel kind of marine propeller made at the Skoda establishment

24 eccentric presses, 42 spindle presses with spindles up to one foot in diameter, 4 air hammers up to 300 pounds in weight, 4 shears up to 2 inches capacity. There is also the gear works with special machinery to produce wheels up to 15 feet in diameter of every material.

The locomotive works, which was founded in 1918, has 4 large buildings devoted to manufacture and repair of locomotives and to boilermaking. Over 200 modern tools produce the mechanical parts in the repair plant, and this young department already employs over 1,100 men and turns out and reconstructs 300 locomotives each year. The area covered is 33,000 square yards.

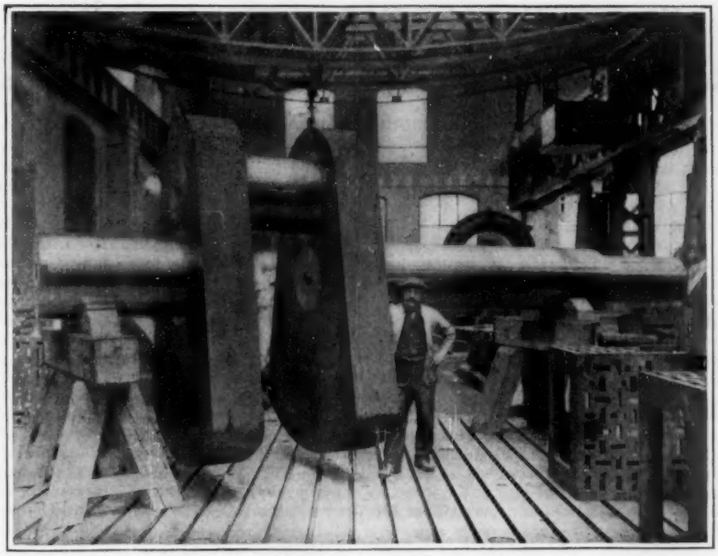
The automobile factory, which is a new department, makes tractors, ploughs and explosion engines. The area covered is 45,000 square yards and there will be employed 1,400 men. Up-to-date machinery is being added which will give a capacity of 900 motor ploughs and tractors, besides 1,000 agricultural locomobiles.

This great munitions plant, which has been famous for many years, is now being diverted to the making of printing presses, agricultural machines and the like. A separate testing laboratory is installed to insure perfect product and the Skoda Works have their own proving grounds where armor plates as well as projectiles and guns are tested. There is a complete munition works in connection with the gun works and there is a special testing plant for these munition works at Nuerschan and Bolawetz near by.

This large electric generating station furnishes steam and current for the entire works, does the driving and heating of the shops and produces oxygen and hydrogen for the welding and cutting flames. Electric current is supplied by the station 1 at the northern boundary of the works at Pilsen and the station 2 at the Pankraz mine in Nuerschan. Interconnection is made by long distance line of 8 miles in length which carries current of 50,000 volts and of 50 cycles.

An extensive mechanical carrying plant is installed for the handling of coal and ashes from and to the coal mines of the works. The main stacks are 250 feet in height and about 12 feet in diameter at the top. Exhaust steam is used for the heating during the winter season and the condensate from the turbines is fed back into the boilers. A filtration plant of 500 cubic feet hourly capacity supplies the make-up water of the boilers.

The turbogenerators range in size from 300 to 10,000 and are of 3,000 volts. There are 313 electric cranes ranging from 120 tons capacity down. Eleven of these are of 60 tons capacity. The installed horse-power of these 937 crane motors is 24,000 horse-power and there are besides 1,050 motors in the works of 25,100 combined horse-power. The oxygen plant is contained in separate buildings, also the hydrogen works. Electrolytic as well as "Linde" systems are here in use.



Part of the shaft of a 10,000 horse-power gas engine under construction at the Skoda plant

The Greatest of Floating Cranes

By Ralph Howard

IT isn't every crane that looks the part. But there are very modern fellows that resemble their namesake pretty well. That is, they are capable of bending over to pick up something. The giant crane built for the British Admiralty is a case in point. The monster is very tall when in erect position. It may readily be bent over to reach a fairly distant load. Other notable instances of gigantic cranes of the same type are the two which are in service at the Panama Canal.

All three of these are mounted upon pontoons and are in consequence styled floating cranes. All of them are capable of lifting a maximum load of 250 tons. But the one which operates in British waters nevertheless outranks the others because it is able to secure and handle its maximum load at a greater horizontal distance. On may readily understand that, while the load lifted is a principal factor in a crane's capacity, nevertheless the outboard reach is also of importance.

Perhaps we ought to mention here another installation—a pair of cranes mounted on a single pontoon—each capable of lifting 200 tons so that the total of lifting ability exercised from the one pontoon is 400 tons. But this is hardly to be undertsood as an ability to lift and transfer, after the manner of a rotating crane, a single load of this total weight. The makers of the British crane claim the palm, and it may very properly be allowed them.

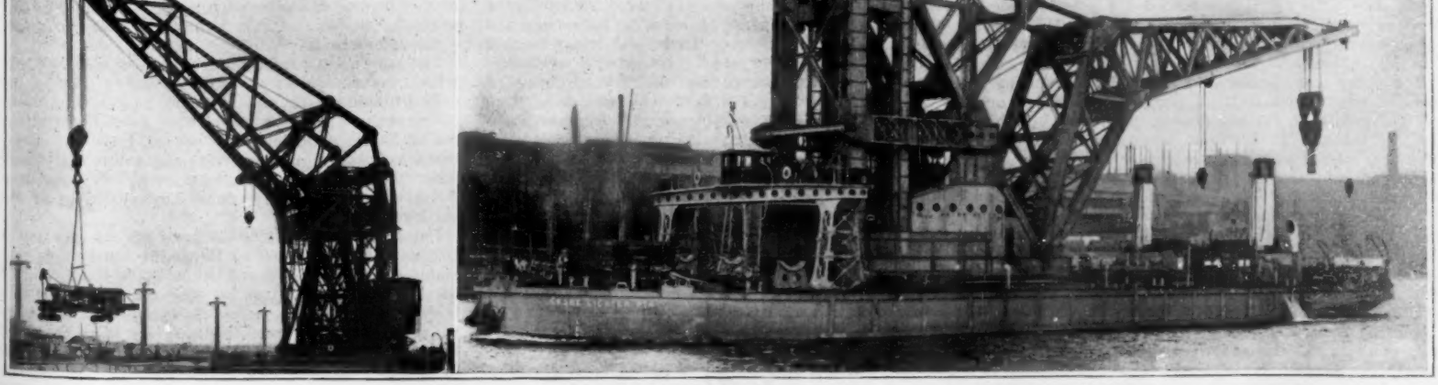
The greatest of floating cranes in the world is known in the British Navy officially by the very commonplace title of *Crane Lighter No. 4*. It lifts 250 tons at a radius of 100 feet. This is its greatest normal maximum effort. But it is capable of other normal maximum efforts. This requires a little explanation.

The arm which reaches out like the neck of a living crane and while at a more or less oblique angle provides support for the hoisting of the load is termed the jib. When the greatest of all efforts is made, the jib has an angle of perhaps 40 or 45 degrees to the horizontal. The lift is not made from the extreme tip of the jib but from a point somewhat back of it. The reach is estimated horizontally from a vertical plane through the center line of the pontoon to the steel ropes which support the load. The gravity pull of 250 tons at a distance of 100 feet from the center of the deck naturally tips the pontoon considerably. The height of the lift possible may be roughly estimated as the difference in level between the hook carrying the load when at its maximum height, and the lowest points of the tipped deck. Measured thus, *Crane Lighter No. 4* can lift the 250 tons at a distance of 100 feet to a level about 77½ feet above the water. Naturally, the block-and-tackle arrangement at the tip of the jib will, under the foregoing conditions, be at a higher level than the inner one. By depressing the angle of the jib, the reach possible with both blocks is increased. When the reach of the inner hoisting rig is at 110, 115, 130 and 137 feet, the possible maximum loads are 200, 150, 100 and 75 tons. At the farthest reach the jib is well-nigh horizontal. The block at the tip of the jib is capable of lifting 30 tons. This load may be lifted by the crane from this block at all reaches of the full jib up to 150 feet. It will be seen from the foregoing statements that this great crane is able to handle a great variety of work.

The pontoon which carries the crane is a pretty big boat, being 242 feet long overall and having a molded breadth of 86½ feet. The center of the base of the crane is somewhat forward of exact amidships. Suitable areas are provided on the pontoon's deck, ahead and astern of the crane for the loads to be handled. Consequently, with the crane exactly alongside of a position on a battleship where a gun mounting is to be deposited, the crane will have the duty of lifting the mounting from the pontoon's deck, swinging itself around through a horizontal right angle and lowering the mounting into place. But there is a further requirement. The reach of the crane when securing the load is much less than the reach of 100 feet which it might be called upon to use in depositing. Necessarily, then, the reach has to be changed while the crane has the load. In fact, it is possible for the unloaded crane to set itself at the start at a reach of only 51 feet from its own vertical axis of rotation.

The base of the crane rests on rollers, these rolling in a path or orbit of 25 feet radius. With the addi-

(*Continued on page 260*)



The view at the left shows one of two identical outfits at Panama; that at the right is of the largest pontoon crane in the world, belonging to the British navy.

Two huge cranes that float on barges and stoop to lift their loads

Succeeding in Safety Engineering

The Man Who Makes Industry Safe for the Worker, and What He May Hope to Get Out of It

By Raymond Francis Yates

THE author feels that this is one of the most important subjects he has treated in this series. Safety Engineering has to do with saving human lives. What could be more worthy? It is described as "the development and application of engineering ways and means of accident prevention." It is an engineering science that has grow out of our complicated, and in many cases treacherously hazardous, industrial development. It is indeed the science of saving life and limb—it is the application of engineering principles to lessen human misery. It is a great humane movement, which, in spite of its youth, has already saved many a breadwinner for his family.

Mr. H. W. Mowery, President of the American Society of Safety Engineers was kind enough to give the author the data embodied in this article. Mr. Mowery has a big, broad humanitarian version of safety engineering and the writer can feel the tang of his inspiration as he writes these lines. As President of the American Society of Safety Engineers, Mr. Mowery is one of the leading spirits of this work in America. Every day he is putting his heart and soul into the work of spreading the gospel of safety.

We will start this article by considering the service a safety engineer renders his country. First and foremost he is a protector of human life. He also prevents men from being maimed and crippled. From an economic point of view he protects that portion of the total casualties yearly, causing a waste of approximately $720,000,000, which is preventable by engineering revision.

What education should a safety engineer have? This is somewhat difficult to answer. It is not only education that is necessary for a successful safety engineer. The personal factor enters into this matter. There are certain personal qualities that contribute to the success of a man working in this field. He must be sort of a "human" engineer also, that is he must know how to engineer human beings. He should be amiable, kind-hearted, patient and quick to see things that endanger life and limb. He must possess a pleasing personality. It is no profession for a "grouch."

The purely technical side of a safety engineer's education must be somewhat general. He should be thoroughly grounded in all the fundamentals of engineering. He must have a good technical education gained in college or outside of college, it makes no difference. The man training himself for this work should be fully conscious of his responsibility. He must realize that he is to be a guardian over human life and that his mistakes are very apt to be sad ones. It would seem that any man educating himself with these facts in mind should try to make a good job of it.

A young man may say to himself, How do I know that I have the proper personality to succeed in safety engineering? He can answer himself by asking himself these questions: How many friends have I? Do I get along well with my fellow workers? Do I get along well with my superiors? Am I a good sport? Do I swear and lose my temper when my collar button drops down the back of my neck or under the dresser? The last question is a good test for patience.

The young man reading this article should constantly keep in mind the fact that safety engineering is one of the infants of the engineering profession. It has not yet reached its economic level and the question of salary cannot as yet be clearly defined. Some men receive $2,000 per year while others are receiving as much as $15,000. It is regrettable that the majority of industries are not as yet thoroughly awakened to the value of accident prevention work. Consequently they do not offer salaries that attract men of the type needed in this work. In a general way it can be said that the salary of an expert in safety engineering would be determined by his value to the organization employing him. In other words it will be determined at present by the amount of saving he makes in compensation, hospital, medical and other direct and indirect losses. Of course the lower these expenditures are the lower will be the number of accident occurring in the factory.

Mr. Mowery informed the author that as yet many safety engineers have not gone into business for themselves. In the same breath he also mentioned that this was probably because of the fact that there are not many real safety engineers. The profession is developing rapidly but at present most of its followers are employed by State labor departments, insurance companies and large industrial organizations. There is a great opportunity for safety engineers to go into business for themselves and provide service for a clientele made up of the smaller plants.

Unfortunately our colleges have not yet recognized safety engineering in their courses. An effort is being made to have the fundamentals of safety engineering incorporated in existing technical courses and a special course created that will officially authenticate those who qualify as safety engineers. The American Society of Safety Engineers is now considering the formulation of a curriculum for the education of safety engineers.

The present demand for men trained in safety engineering is far in excess of the supply. Mr. Mowery believes that it will be for many years to come. It will surprise many to know that thirty-nine States of the Union have some form of Workmens' Compensation Law. The demand has grown rapidly as a result of the urge from State labor departments, insurance companies, etc., to safeguard employes. At present, most of the recommendations are made by inspectors from insurance companies and State departments. The employer will eventually call in a safety engineer to cure unsafe conditions in his plant just as he would call in a physician to cure any unwholesome conditions of his body. There are several companies which make a specialty of providing such services to industrial establishments.

EVERYBODY who works with his hands knows that today there is a great deal more attention paid to means for helping him avoid accidents than there was some years ago; and everybody who reads knows that there is a lot more talk about this sort of thing than ever before. But perhaps everybody does not know that the effort to make industry safe for the workers has given rise to a new profession. In the beginning, doubtless, it was left to the mechanical engineer to make machinery safe, and to the electrical engineer to make electrical apparatus safe, and similarly in other fields. Today, however, it is found that with one man to attend to all this, to co-ordinate the work in the various fields, and to bring the legislative and medical angles of the proposition into harmony with the practical, the results are so vastly improved that the safety engineer amply justifies his existence. In this article Mr. Yates considers the further point of whether the opportunities in this field justify a young man in making it his profession.

—THE EDITOR.

It seems that there is no great demand for specialists in safety engineering. It may be that a man may become better qualified, through experience, to handle electrical hazards than other kinds. Another man may specialize on hazards in chemical industries, another in railroad work, etc. In general it can be said that a safety engineer should be capable of intelligently handling any kind of hazards. The author asked Mr. Mowery how long a man should train himself to become a thoroughly capable safety engineer. He said that everything depended upon the man, and added: "One cannot expect to master the fundamentals of engineering, and of safety engineering in particular, by listening to a course of a dozen lectures, and while I am certainly disposed to approve the custom of holding night schools for foremen, giving them condensed interesting talks on safety of a nature to bring about their coöperation, however, I surely do not approve of giving them diplomas indicating that they have graduated from a course in safety. It creates a wrong impression in the minds of the men, and serves to lower the standard of safety engineering through possible misunderstanding. Recently a foreman, having graduated from such a course, advertised for a position as safety engineer, describing himself a 'good mixer.'

"The idea that I have had in mind for years, and which I think it would be well for every safety engineer to have, is, 'to make material conditions so safe that a person may pursue in safety his normal activities without abnormal care.' I believe that educational activities and general propaganda are vital to the spread of the gospel of accident prevention, but I believe that actually to prevent the accidents the material conditions must be made safe. People—whether educated in safety practices or not—at least will not be injured by a hazard removed.

"That there will hereafter be some form of safety engineering is sure. But whether the activities directed to prevention of accidents will be continued by lawyers, doctors, favored nephews, foremen, etc., or by members of the various safety engineering professions becoming inoculated with the safety idea so thoroughly that they will incorporate it in all of their work, thinking of safety in preference to the activities whereby they have gained their distinguishing name; or whether it will be necessary to establish another branch of engineering to be known as 'Safety Engineering' remains to be seen. I am inclined to be of the opinion that safety engineering as a profession, to cure conditions that are causing the present great waste in life and property, is surely developing. I believe the safety engineer's work is becoming clearly defined and he need make no apology or abject pleading for his profession. In a single plant, he has reduced the casualty cost of $35,000 per year, in 5 years' effort to $4,500 per year. But it is unreasonable to expect mechanical, electrical, or any other type of engineers to do other than stress those phases of engineering through the practice of which they have obtained and retain their distinguishing name. They will not stress safety engineering any more than will a physician or a dentist. A certain type of engineer strives to create something in his particular line. He views his work from that angle. If it is a means of production, a safety engineer will be called in for he will look at it from an entirely different angle, namely, safety to life and limb rather than quantity or speed of production. He sees that it is safe; that is his duty, his profession."

There is great opportunity for a display of genius in the safety engineering field. Already the patent office has granted a large number of patents dealing with safety devices. We are at the dawn of the safety age. Safety engineering is not only the application of engineering principles to life protection, but also the science of developing and perfecting additional devices that make dangerous industrial operations safe. The well-known punch press is an instance of safety engineering applied to dangerous machines. A few years ago the punch press was responsible for the loss of a great number of hands and fingers yearly. Along came the safety engineer and today these presses are "muzzled" and with reasonable care on the part of the operator there is not much excuse for accidents. If the hand is under the die when the press is tripped the ram will come down a certain distance and stop.

The safety engineer has encased belts, covered gear wheels, made men wear goggles, put spikes in the ends of ladders, illuminated dark places, made men cut sleeves off short when working around machinery, put railings where they were needed, improved insulations, ventilated our factories—and these with many other things he has done in such a way that their doing has actually been financially profitable to the employer.

Nothing must escape the keen eye of the safety engineer. There are two things he must keep constanly in mind. First and foremost is the saving of life and limb. Then, too, he must remember that this is to be done with a minimum sacrifice of efficiency. In most instances there is absolutely no sacrifice of efficiency, and, in some cases, there is an actual gain in efficiency through the introduction of safety methods. When a workman feels that he is protected it instills confidence in him and he may work faster without keeping his mind on protecting himself.

Names That Live in Our Language

Some of the Men Whose Exploits Are Commemorated by Nouns and Adjectives

By D. Waterson

THE desire to be remembered or to have our dead remembered has existed since the world began. Thousands of human-built memorials have long ago crumbled to dust, but mountain and river, tree and flower, state and town and mineral perennially perpetuate a name, though the bearer and that which he did are but dimly recalled except by the erudite. *Pike's* Peak, the river *Livingstone*, *Douglas* pine, *Dahlia* blossom, *Pennsylvania*, *Carnotite*, etc., are memorials of worthy men.

Some names have passed into everyday speech, some are adjectives, every great discovery or international crisis erects another mental monument, especially war, though, after a time, many perish altogether and the others require a biographical dictionary for elucidation.

It would be particularly puzzling to decide which of the proper names that have entered into the current slang and semi-slang of the day will and which will not survive. Merkle and Dr. Cook as symbols of utter stupidity and fraudulent claims have been crowded out by the latest sporting idiom, which refers to knock-outs and home runs as Jack Dempseys and Babe Ruths; will these terms, too, pass along with the bearers of the names which they commemorate, or will they become a lasting part of the language? The answer to this query is perhaps less doubtful in the case of scientists and inventors than in that of sporting idols and nine-day occupants of the front page of sensationalism; but there must always be some doubt. Nevertheless, a great multitude of such terms survive in the body of unquestioned English.

Particularly striking is the large group of memorial names in the electric and radioactive world; I have grouped a few together to interest those who constantly use the terms yet do not know their derivation:

The measurement for pressure or electromotive force is a *volt* named after Alessandro Volta (1745-1827), an Italian physicist, originator of the electrophore, electroscope and the Voltaic pile and who proved Galvani (*galvanize*) wrong in his theory of animal magnetism.

The student reads that the *ampère* unit of electricity gives the rate of flow, i. e. it takes one *volt* of pressure to drive a current of one *ampère* strength through a resistance of one *ohm*, but he does not gain the additional interest of knowing that André Marie Ampère (1775-1836) was a French electrician and "the father of electro-dynamics," who found that two parallel conducting wires attract each other when the current traverses them in the same direction but repel each other when the current flows in opposite directions. George Simon Ohm (1789-1854), a German physicist, claims the *ohm* law that the electromotive force divided by the resistance is equal to the strength of the current.

The *watt* is one *volt* multiplied by one *ampère*, but James Watt (1736-1819), inventor of the condensing steam engine and his work is generally known. The unit was too small to be convenient, so electricians adopted 1,000 watts as a commercial unit of power and named this a *kilowatt*.

The *coulomb* brings into view Charles Auguste de Coulomb, a French scientist (1736-1806), who invented the torsion balance, which gave two new inverse square laws in addition to the Newtonian one of gravitation. A *coulomb* is the quantity of electricity required to produce a definite chemical effect—to deposit 1.1183 milligrams of silver.

And a *mache?* It was a German physicist, Heinrich Mache, still living, and his co-worker, St. Mayer, who hold this unitary honor, the unit representing the quantity of radium emanation, without disintegration products, which produces a current of limited saturation.

The *joule* is named after James Prescott Joule (1818-1889) of Manchester, England, the unit being the energy expended in one second by a current of one *ampère* passing through a resistance of one *ohm*.

It is hardly necessary to mention the origin of the *Curie* unit, which represents the quantity or mass of radium emanation in equilibrium with one milligram and one-thousandth of a milligram respectively, for Marie Curie is still working, though Pierre Curie is dead. She was greatly pleased when the Radiology Congress in Brussels, 1910, determined on the name in memory of the splendid work achieved by the Curies.

I have chosen but one little group, but enumeration of all would take a long article. The *farad* unit (Michael Faraday, 1791-1867) from which faradization comes, could be added, and most readers know of *mesmeric* powers and of being *mesmerized* (Franz Mesmer, 1773-1815).

Galvanic, *galvanized* are equally familiar. Luigi Galvani (1737-1796) was a professor of anatomy at Bologna and was noted for his investigations in the contractions produced in the muscles of frogs by contact with metals. This was the beginning of galvanic or voltaic electricity.

There are dozens of names which are used as adjectives: *Hertzian* waves, *röntgen* rays, *coolidge* tube, and, to step a little outside the scientific world, who does not enjoy having a *mackintosh* in winter and the smooth *macadamized* roads? Charles Mackintosh, the Englishman who, in 1823, found he could apply naphtha to cloth and so render it rain-proof, was also doubtless pleased, and John Macadam (1756-1836) certainly found the English roads in a horrible condition when he brought his engineering skill to work on them, France quickly adopting his theories. Another "Mac," this time Macassar, invented a wonderful hair oil early in the 19th century, which was so freely used and the oiled heads so bad for stuffed furniture that "anti-Macassars" came into general use. When Sir Robert Peel instituted the London police force, they were and are known as "Peelers" or "Bobbies."

Some men's characters are perpetuated as uncomplimentary adjectives. All know the *Judas* kiss, a *Macchiavellian* policy (Nicolo Macchiavelli, 1469-1527); and Louis Daguerre (1789-1851), who belonged to the French Internal Revenue Service and who afterwards, with Niépce, invented photographing on metal, had such a reputation for indecision and unreliability that anyone possessing the same faults was spoken of as a mere daguerreotype, or shadow of a man.

It is seen then, that some names will be used forever as terms of honor or dishonor even though the owner as an individual is forgotten. Even today how much does the average person, reading advertisements, know of what splendid achievements and benefits *listerized* gum and *pasteurized* milk remind the man who has read of Lord Lister and Louis Pasteur?

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Ventilation of the Hudson River Tunnel

To the Editor of the SCIENTIFIC AMERICAN:

That the construction and completion of the tunnels under the Hudson River at Canal Street, intended for vehicle traffic will be a great convenience is proven by the daily congestion at the ferry entrances on both sides of the river. Along with their urgency there is the great importance of proper and ample ventilation without which the tunnels would be useless. The greater number of vehicles, probably 90 per cent of them, will be automobiles and motor trucks, exhaling poisonous gases. On this point the *Literary Digest* for August contains a very instructive article. It concludes with the warning that the contents of carbon monoxide (the most poisonous gas contained in the exhalations of motor vehicles) must not exceed the maximum of four parts in ten thousand parts of air. This conclusion has the endorsement of the United States Bureau of Mines, but the solution of the problem is left entirely to the engineering department of the Commission.

Although a novel problem, the principle of it is simple and easily understood. Fresh air is conducted through a duct the entire length of the tunnel from which holes short distances apart admit the air to stream into the tunnel and dilute the poisonous gases. Another duct, also running the entire length of the tunnel and also connecting with the tunnel through numerous holes, sucks up the contaminated air which is expelled through shafts at each end by mechanical blowers. The ventilation is therefore crosswise of the tunnel and a continuous operation which requires careful designing for its success.

Let us believe that the engineers of the Commission have thoroughly studied the problem, yet it is of such overwhelming importance that the details of that study should be published as proof thereof.

To mention only one point. The velocity of air and gases through the ducts will be very great. The friction along the walls of the duct and through the orifices will consume a great deal of power, which will increase rapidly as the walls of the ducts will become incrustated from the dirt and oily particles in the air. The surface of the ducts will therefore require periodic inspection and cleaning similarly as chimneys require cleaning from soot. To that end the height of the ducts should be sufficient for a man to walk through from end to end, 8,000 feet long. But the height in the plans is only 4 feet 8 inches for lower duct and about 5 feet in upper duct. These heights are too low and would require continuous stooping of the workmen, which is both exhausting and tormenting in long, hot ducts.

Ordinary foresight also requires that in the lower duct provision be made for carrying off the dirt on some narrow gage railway. The upper grating seems hardly strong enough to bear the weight of men.

The clear height of tunnel is only 13½ feet, while the minimum of clearance on our streets under the elevated structure is 14 feet. From all this it appears that the diameter of 29 feet should be increased at least to 32 feet.

No short-sighted economy should expose the users of the tunnel to poisoning by insufficient ventilation. On this point the details cannot be too specific and should be published. The Commission would assume a great responsibility in ignoring this justifiable demand.

MECHANICAL ENGINEER.

Some Questionable Botany

To the Editor of the SCIENTIFIC AMERICAN:

May I call your attention to some rather unfortunate terms employed and statements made in the article on page 651 of your issue of June 12th?

In the first paragraph we have reference to the "progress in artificial fertilization of seeds." Without comment on the rather unimportant fact that seeds are not fertilized, because of the ovules which are present in the ovary of the flower cannot develop into seeds until they have been fertilized, I want to call attention to the fact that it is not artificial fertilization but artificial pollination which the plant breeder practices. That paragraph and the next contain several loose statements which I pass over lest I seem pedantic; but it is impossible to ignore the sentence reading "As our photographs show, this operation (artificial pollination) consists in elevating the anthers of the flower to be fertilized, then in depositing upon these the pollen of the fertilizing variety." The pollen, of course, is deposited upon the stigma of the pistil, not upon the anther of the stamen.

While I am at it I wish to comment on the letter published on page 645 of the June 12th issue and signed by Homer J. Carleton of Los Angeles. The letter refers to "earth preserved eggs" which Mr. Carleton reports having been offered for sale at Pasig, P. I.

I feel sure that Mr. Carleton must be mistaken in his belief that these eggs were in any way similar to "the ripened eggs of the Chinese." The eggs of which the Tagalog of the provinces near Manila are so fond and which are called facetiously by the Americans "chicken on the half-shell" are, as a matter of fact, not eggs but chickens, for they are nothing more than eggs which have been incubated almost to the point of hatching and then boiled. They are called "balut" or "baloot" by the Tagalog, and are peddled at every station along the railroad running from Manila into La Laguna and Batangas provinces.

During three years' residence in Manila and on the shores of Laguna de Bay I have met many Europeans who professed great disgust at the natives who ate "baloot"; but, though I have never been able to carry my philosophy into action I cannot even yet understand why, when eggs are good to eat before hatching and chickens good to eat after hatching, eggs should not be good food while they are being hatched into chickens!

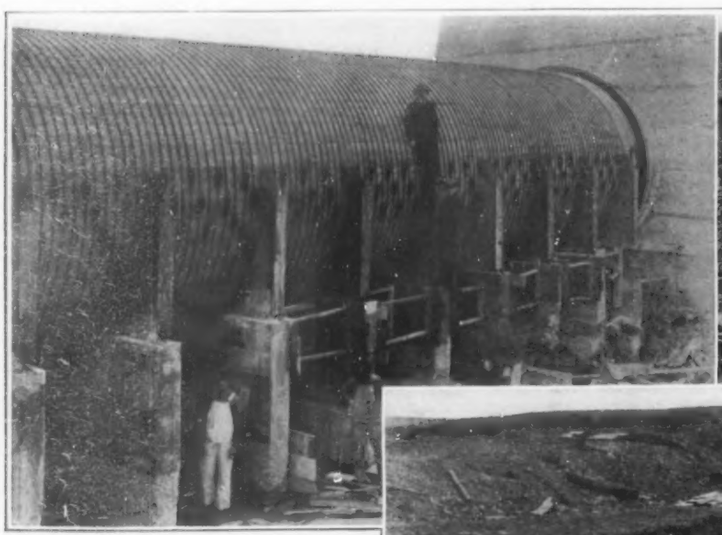
[PROF.] RICHARD M. HOLMAN.

Crawfordsville, Ind.

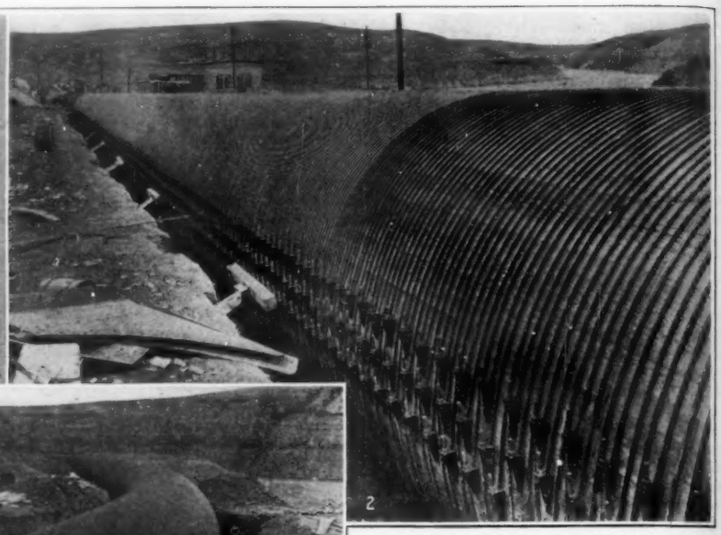
Water Pipes of Wood

The Surprising Permanence and Tightness of This Unusual Construction

By J. F. Springer



1. Exposed pipe laid on foundation of concrete wings.



2. Pipe line which will lie partly covered and partly exposed.

3. One of California's biggest pipe lines is of wood.

MANY persons who have not kept in touch with engineering developments of the past few years will perhaps be surprised to learn that wood stave pipe has come into use for the transport over long distances of large quantities of water and the like. Wood, to many of us, seems ill-adapted for out-door service, if long life is to be required. And yet, wooden piles have for a great many years been considered as thoroughly dependable. This is especially the case where the entire pile is well submerged below the water line. Such piles have been taken up after long service and found to be in just about as good condition as when put down. With facts of this description in mind, we shall perhaps be better prepared to understand the use of wood stave pipe in important engineering undertakings.

One of the early instances of an important wood stave pipe line is the semi-cylindrical half-pipe or flume laid in Utah in 1893. The diameter here was 48 inches. The water carried varied considerably in quantity. The maximum head was 70 feet. The whole of the flume was above ground and part of the line was exposed to the full heat of the sun on one side. When 31 years old, this pipe was inspected and the wood found to be undecayed. A sugar factory in California built in 1902 had wood stave pipe for discharge purposes. However, this pipe was in service 4 months of the year and idle 8 months. The engineer concerned not so long ago thought the pipe would have a life of 50 years. Palo Alto, California, near San Francisco Bay, has a sewer of wood stave pipe which runs across the salt marshes on the coast. This line is in part fully buried, in part half buried, and in part completely exposed. Flood tides cover it, at least in part, and ebb tides leave it exposed. It was said, a year or two ago, to be in perfect condition. In 1900 there was built for the water supply service of San Diego and Coronado, both in California, a total of 7½ miles of wood stave pipe—about one-third being of 40 inches diameter, and the two-thirds of 36 inches. The water pressures vary between those due to a head of 150 feet and a head of 295 feet. For nearly the whole length, the pipe line is buried in alkaline soil, but some short lengths are carried across deep ravines on trestles. In 1916 this line was examined and found to be in excellent condition. In fact, it is claimed that the wood was harder than it was originally. Just about all the foregoing pipes were constructed of redwood timber.

It will be seen from the foregoing that wood staves have been tried out under severe and varying conditions. However, there is wood pipe and wood pipe. Just any kind of wood will not suffice. One of the principal requirements that the material which enters into the body of the pipe must fulfil is that it shall resist decay, even if it is not perpetually saturated. Where constant saturation is to be depended upon, several kinds of wood will answer. In fact, perpetual saturation tends to prolong the life of wood in general. There are, however, other considerations which wood pipe must generally fulfil, and these tend to cut down the possible kinds of wood. Redwood, fir, cypress and pine are all in actual use for wood pipe. It is claimed that pitchy woods, like fir and pine, will not last under conditions of partial saturation. The pitch is cited along with the sap as having a tendency to produce deterioration, even if there is saturation. On the other hand, the Canadians have constructed a continuous wood stave pipe line, 8 feet in diameter, of British Columbia fir. This is a good big fellow and indicates Canada's faith in Canadian wood. An American engineer specializing in wood pipe says that fir and pine will, under certain conditions, have a long life and give perfect satisfaction. Thus, if the climate is dry, either wood may be expected to do well, if the erection is such that a circulation of air obtains all round the pipe. Heavy pressure of the contained water when combined with imbedment in compact soil promotes long life. Pressure water is good because pressure produces saturation or tends to do so. Redwood and cypress are said, in some quarters, to be about the only commercial woods suited for alternations of wet and dry climatic conditions. Cypress is, however, said to be becoming more and more unobtainable, except at a price. Apparently, there exist only a few cypress pipes.

Redwood is claimed as really the best commercial wood for pipes and as surpassed only by cast iron in respect to length of life. There seems to be a peculiar constituent of this wood of an acid character. It is of importance as it preserves the fiber against destruction by micro-organisms.

In building wood stave pipe lines, the engineer must be content generally to let cost have serious weight. He will generally have to take some middle course. Thus, thick staves give the better pipe, and wide staves mean reduced cost of erection. But, a pipe is not necessarily as much better as the staves are thicker. And a wide stave may not result in enough saving in erection to pay for the waste of timber thus brought about. A nominal size of 2 x 6 inches has been put forth as a good size of stock for economical manufacture of staves, all things being considered. The nominal thickness and the nominal width will be cut down somewhat. The stock size given will be suitable for all pipe sizes from 26 to 52 inches. In general, the thickness of the stave will vary with the diameter of the pipe. But other considerations enter.

Water pipes of wooden staves with hoops of steel

A wood pipe must favor penetration of the water. But it must not permit excessive percolation. The wood may be dense and hard. This may hinder perfect saturation. Then, the wood may consist of alternate portions of hard and soft material—winter and summer wood—under which circumstances excessive percolation is to be feared. The water will find its way out through the soft material between the regions of hard material. Redwood is a very soft and cellular wood. If the sap has been got out, it is resistive to percolation and favors saturation. However, different staves in the same pipe will often differ in the combination of their resistances to percolation with their facilitation of saturation.

It is considered important in constructing a wood stave pipe line that the staves be quite dry at the time of erection. The reason for this is that then the bands may be cinched tight, and the whole pipe made tight when dry. When such a pipe undergoes in service the experience of having the water drawn off the line, the shrinkage of staves, and the consequent opening up of seams, has been forestalled. Even though there should be some shrinkage and some opening up, the return of the water will produce enough swelling to result in tightness. If wet staves are used, they are already swollen; so that the withdrawal of water from the line will result in excessive changes, changes too great for the returning water to rectify with certainty.

The lumber which goes into a pipe line should, it is asserted, be thoroughly air dried. This is the natural process. Kiln dried lumber is condemned, if the drying is carried out by the older process. There is a newer procedure which employs steam indirectly, and makes use of a circulation of air having a proper temperature and a proper humidity. Under the old kiln process, redwood is said in effect to become flinty and capable of being broken into splinters over the knee.

The engineers having to do with wood pipe have not been altogether in agreement as to the matter of

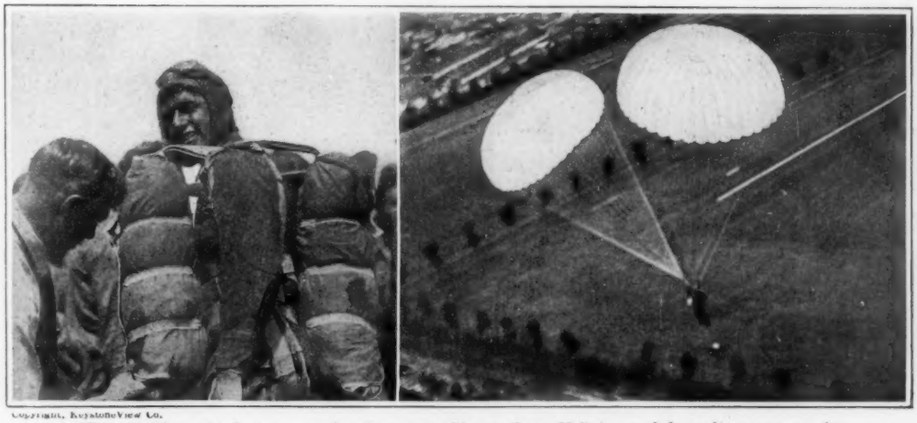
(Continued on page 262)

Making Doubly Sure of the Parachute Jump

AVIATION is getting safer every day. Not only has the airplane been made safer in many different ways, but it is being equipped with parachutes for use in the event of an involuntary descent. And now comes the latest safety device for aerial travelers, namely, the double parachute which makes a parachute descent just twice as safe as with the conventional single parachute.

The United States Aviation Corps has been conducting a series of experiments with the new double parachute. Sergeant Gilbert A. Shoemaker, a veritable daredevil aviator, so we are told, has been using the double parachute with excellent results.

It appears that this device can be used either single or double at a time. If one parachute fails to open, which sometimes happens, the other by all the rules of probability should open. Again, if the descent is too rapid, the second parachute can be opened so as to lessen the rate of drop. The accompanying views show how the double parachute is worn by the aerial traveler and how it functions during a big drop of several thousand feet.



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The double parachute worn by Sergeant Shoemaker, U.S.A., and how it opens up in a 5,000-foot parachute jump

Towing a Ship Across the Pacific

WHEN the tug "Hercules" on April 9th steamed into the harbor of Vancouver, Canada, towing the five-masted auxiliary schooner "Laura Whalen," a new Pacific Ocean towing record was established, one not nearly approached in many years in marine annals. The "Hercules" brought the schooner from the port of Papeete, Tahiti, in the South Seas, a total towing distance of 4,630 miles.

The "Laura Whalen" is one of a dozen five-masted schooners built of British Columbia fir which were constructed during the war specially designed as wheat and lumber carriers. Sailing on her maiden voyage on April 25th, 1918, a long series of disasters attended the ship. Lastly, after crew desertion, much engine trouble, she put into Papeete a few months ago with her rigging almost stripped, damaged engines and a ruined cargo of tallow, wheat and hides. The tallow had been carried as a deck load. Some of the casks became broached by storm. The hot South Sea sun melted the tallow which ran into the hold and mingled with the wheat. Having discharged her cargo and finally been pronounced unseaworthy to carry cargo, the "Laura Whalen," with fifty tons of ballast, was taken in tow on March 3rd by the tug "Hercules" and arrived in Vancouver on April 9th.

Australia's Railway Gages

APPROVAL has been given to a proposal to give a uniform gage of 4 feet 8½ inches on the railways connecting the capital of the mainland Australian states from Brisbane to Perth. It is estimated that this will cost $120,000,000 of which the Commonwealth is to contribute one-fifth, the five states concerned finding the rest on a per capita basis. The Commonwealth line from Port Augusta to Kalgoorlie, 1,057 miles, which is one of the main links in the connection, is already on the 4 feet 8½-inch gage as are the New South Wales lines. Western Australia would have to convert 375 miles of 3 feet 6-inch line, Victoria 200 miles of 5 feet 3 and South Australia several hundred miles of 5 feet 3 inches, and 3 feet 6 inches, while Queensland would have to build 100 miles of new 4 feet 8½-inch line. It is also proposed to build several hundred miles of new line in New South Wales and South Australia in order to shorten the distance by rail from Brisbane to Perth, now 3,300 miles, by 469 miles. The conversion of the other lines in Australia to the 4 feet 8½-inch gage would be done later in piece-meal fashion. There are 22,046 miles of railway on the mainland of Australia, the proportion in the different gages being 5 feet 3 inches, 5,149 miles; 4 feet 8½ inches, 5,881 miles; 3 feet 6 inches, 10,866 miles; under 3 feet 6 inches, 150 miles. The cost of converting to the 4 feet 8½-inch gage all the lines not provided for in the $120,000,000 scheme recently adopted has not been estimated but would probably amount to $500,000,000.

Again, the Water Bicycle Races

FRANCE has always been partial to new and odd methods of locomotion. It was France which first fostered the automobile when it was a feeble, balky, uncertain and unpromising thing; France placed her faith in the airplane even before the Wrights gave their practical demonstration of heavier-than-air flying; and now France is playing with water bicycles, winged bicycles and other toys, so to speak—but these are toys which may yet prove practical in the no distant future.

Another water bicycle race has just been held, this time at Enghien, just outside of Paris. As in previous contests of this sort, all kinds of queer contraptions participated in the race. Some contestants used craft driven by airplane propellers, others made use of the usual marine screw, while still others made doubly sure of their locomotion, so it would seem, by using airplane propellers and marine screws in combination. As luck would have it the simplest form of machine won. This machine, No. 5, driven by M. Bernard, won nearly all the races. In fairness to M. Bernard it is well to call attention to the fact that the driver, who must work the pedals as in bicycling, deserves just as much credit as the machine, if not more so.

The pedals of the water bicycle serve to drive the propeller or propellers, while the handle bars operate one or two rudders for steering purposes.

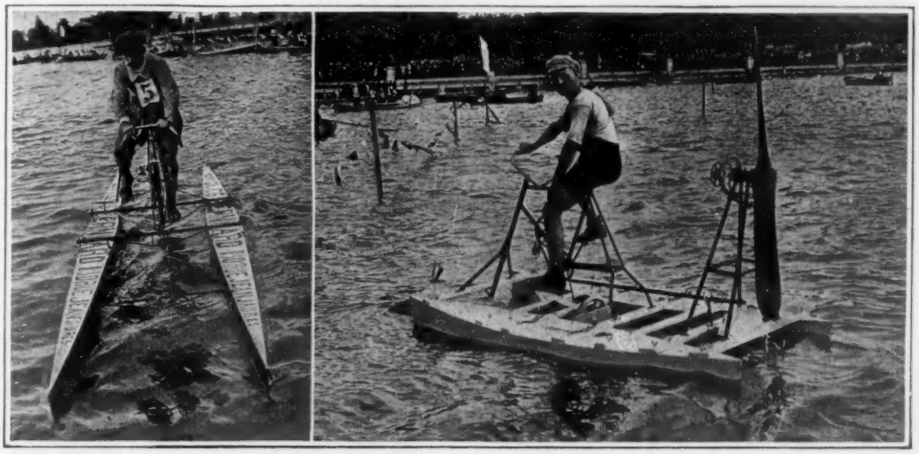
This modified form of canoe, equipped with 15-horse-power engine, makes 25 miles per hour

Thermometer Deterioration

EVEN thermometers become old, and consequently inaccurate with age, mercurial instruments reading too high and spirit instruments too low. In the former case the bulb appears to shrink, thus forcing the quicksilver too far up the stem. This gradual shrinkage is supposed to be due to the fact that the external pressure on the bulb may be considerably higher than the internal pressure, the air as far as possible having been removed before the glass is sealed off. On the other hand, the spirit thermometer is sealed with the bulb covered in a freezing mixture, in order to lock up in the glass as much air as possible. The instrument thus starts with an internal pressure which in time appears to be reduced either by expansion of the glass under the internal pressure or by leakage.

Turning the Canoe Into a Speedy Power Boat

EVERYONE is more or less familiar with the speed and easy-going characteristics of the canoe. And everyone has at some time or other come across the engine-driven canoe—generally a canoe equipped with a small gasoline engine of one-half to two horse-power. Now comes William H. Wray of Brooklyn, N. Y., with a modified form of canoe which he has equipped with a 15-horse-power twin-cylinder motorcycle engine. This odd power boat is sixteen feet long and carries three passengers. The engine drives the propeller by means of a chain. A speed of 25 miles per hour can be readily maintained.



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Left: The winner of the water-bicycle races. Right: A contestant with his combination marine screw and airplane propeller machine

Technical Sponges

A SPONGE can be briefly defined as the skeleton of certain aquatic animals—naturally there are a number of varieties. This skeleton while being fairly strong when first used, gradually softens and breaks down through use and bacterial action. A patent for a tanning process has recently been issued to W. H. Allen of Detroit whereby the strength of the sponge is greatly increased and also increased resistance to bacterial action. The sponge is chemically in the same class of material as hides, and we know the lasting qualities of good tanned leather; therefore, it is to be inferred there is a good fortune for the tanned sponge.

Left: Testing the meter for accuracy with the automatic proving machine. *Center:* Pitting the indices of eighteen service meters against three master instruments. *Right:* Public Service Commission tester filling his proving machine to get the necessary gas to test a group of meters.

Where New York's gas meters are proved to be accurate before they go into use

Checking Up the Gas Meter

How New York's Consumers Are Assured That They Get What They Pay For and No More

By William R. Andrews

IN New York City about four thousand new and used gas meters are tested each week for accuracy, first by the gas company, then by inspectors in the employ of the Public Service Commission. The result of one test made not long ago showed a general average in favor of the consumer by 1.79 per cent. A similar low percentage became evident in the tests of 59,475 meters made by the Massachusetts Gas and Electric Light Commissioners. The figures of the Board revealed the fact that only 206 of these meters were inaccurate. A few were fast, and those that registered slow were found to average 3.78 per cent over the average of the fast meters. Here again the results favored the consumer.

The gain by the public through such percentages as these is due to legislative enactment in the various States where commissioners have been appointed to supervise the relations between public utilities and the consumer of gas, water and electricity. For instance, in New York State gas meters are not allowed to run over one-half of one per cent fast, a trifling gain for the companies. The net result is so small that the tolerance may be compared to the one-eighth of an inch variation in a mile allowed a civil engineer in running a line for railroad trackage. It is pretty evident that the "gain" is almost infinitesimal in both instances. But there is still another factor to be reckoned with—the commission permits a meter to run two per cent slow. Thus the consumer whose meter fails to register correctly in this particular is the gainer, and by legal cognizance. If on test this discrepancy in the action of the meter is found the gas company cannot collect arrears. On the other hand a rebate is allowed if tests show a meter has been running fast.

Notwithstanding the advantage to the consumer in the few instances of meter variation in his favor, the law governing such cases was not passed with any idea of favoritism. The purpose was to meet the exigencies of certain mechanical contingencies which might affect the equitable distribution and sale of the company's product and its payment.

Curiously enough these statutes safeguard the consumer in a way he little realizes. The ancient law of *caveat emptor*, which governs the purchase of practically everything except electricity from a public utility corporation, seems to have become inoperative in his case. For, as gas is standardized in quality and fixed in price by law, he does not, when dealing with a gas company, buy at his own risk. As to electricity, the parallel applies only to the price-fixing by public service commissions. Everyone knows, of course, that there is no such thing as a possible variation in "quality."

All meter tests in New York City are conducted in the meter and appliance repair shops of the gas company at 111th Street and First Avenue. The building is 100 by 200 feet and is ten stories high. The meter department however occupies only three floors. The rest of the premises is used for general repair work, the storage of material and the testing of gas appliances—stoves, heaters, ranges, etc.

The overhauling of 4,000 meters a week is no slight undertaking and the cost of the meter tests is borne solely by the company. A considerable force of workmen is maintained and the burden of expense is not lessened in these days of plutocratic labor when an experienced meter tester draws a wage of $60 a week.

Meters to be tested or in need of repair are first sent to the central collection stations of the districts in which the company has divided the city. Thence the meters go to the 111th Street building and are sent upstairs to the testing department on trundle trucks in lots of 200 or less. There are eighteen sizes, ranging from the three-light meter to those which measure the gas consumed by 300 burners. Only a small portion of the meters received are sent to be tested at the instance of the consumer. The majority have been taken from apartments, private dwellings, stores, office buildings, shops and places of amusement in accordance with a prescribed routine. Experience shows that the wear and tear on the mechanism makes it necessary to remove a meter for repairs after six years' service. The overhauling and testing operations number thirty-two and cover a period of three weeks.

For the initial test an instrument called a meter prover is used. This consists of a large metal tank, filled with water, three and a half feet in diameter and about as high as a man's armpits. A cylinder of galvanized iron is suspended with a counterweight from a wheel at the top of a metal frame secured to the rim of the tank. The upper part of the apparatus towers considerably over one's head. Thermometers, a syphon pressure gage and a hose are the principal parts of the equipment. The gage is used to detect leaks, and a vertical metal scale on the cylinder shows any deviation in the meter's registering device when the gas used in the test moves the cylinder up and down in the water.

Besides these machines there are in use on the same floor several automatic provers invented by Marshal Cornine, the superintendent of the meter and appliance shop, and installed about 12 years ago. His invention saves considerable time. For instance: The tangent connected with the top dial over the indices on the front of a meter is set to make one complete turn to register two cubic feet in the tests. On the old style machines the tangent must be run twelve times. But the same result is obtained on a Cornine prover with one revolution of the tangent. The automatic provers are used for the smaller meters and the other type for the large sizes. All the provers are inspected by Public Service experts, who place the seal of the commission on each prover as it is shown to be correct in its operations.

A complete record is kept of every meter brought to

(Continued on page 264)

Left: The bottom of the gas meter, as it appears when opened to see whether the diaphragms are properly flexible. *Right:* At the top of the meter, where valves must be clean and in place, gears properly meshed, and stuffing boxes tight.

Investigating the internal workings of the gas meter

America's Bid for the Gordon Bennett Cup

By Austin C. Lescarboura

AFTER all is said and done, it is the spectacular side of aviation that appeals to all of us—at least to all of us who are interested onlookers; for the aeronautical engineer and the man who has invested his money in winged travel are interested in a collection of facts and figures which mean little if anything to us. The greatest altitude, the fastest flight, the longest sustained flight—these achievements represent to the layman the momentary status of aviation.

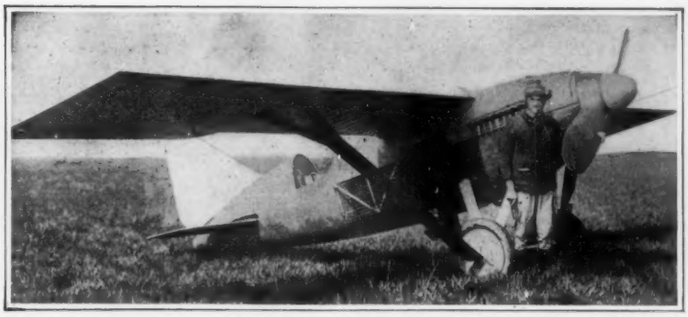
So, speaking in the layman's language, we are to have an exposition of what has been accomplished in airplane design and construction during the past decade or so. The great international race for the Gordon Bennett Cup is to be staged in France on September 27th, and there is little doubt that the world at large will be astounded at the bursts of speed of many of the contending machines. It is only a short while ago that the first aerial meet was held at Rheims, where, on August 29th, 1909, Glenn H. Curtiss, piloting a Curtiss biplane with a 50-horse-power engine, beat the Frenchman, Bleriot, by six seconds over a twenty-kilometer course. He had traveled at a rate of 46.5 miles an hour.

In the coming contest no machine which cannot attain a speed well over 200 miles an hour need be entered. It would be ludicrous to enter such a "slaw" machine. Again, it seems that any machine with less than 250 horse-power has no place in this coming race; indeed, we shall no doubt witness machines with as high as 600 horse-power engines participating. It has been rumored that some of the European contestants may employ engines of 1,000 horse-power!

The race is to be held at Etampes, near Paris, over a circuit course of 300 kilometers (about 180 miles). The start and finish will be at Etampes. Many monetary prizes are offered, aside from the Gordon Bennett Cup, which goes to the victor. Great Britain, France, Italy and the United States are among the twelve entries. While Germany is barred from this contest, it is rumored that German aircraft constructors have entered several of their machines through the neutral countries, most likely Holland, Denmark and Sweden. One feature of this great race is that pilots may use their own fuel. Thus it becomes possible for the contestants to resort to various synthetic fuels which have been developed for aviation purposes. It is understood that the Dayton-Wright machine will use synthetic fuel. Again, supercharger equipment is permitted, and no doubt more than one contestant will make use of this latest device for ensuring maximum engine efficiency. Hence this race becomes a real and fair test of the machine, the engine and the fuel, as well as the pilot.

Three machines have been entered by the United States for the great race. Two of the three machines are monoplanes, while the third, the Army Air Service entry, is a biplane. All three machines have been designed around some particular engine instead of the usual practice of fitting the power plant to the plane. And each machine has made better than 200 miles an hour in test flights, which speaks well for America's chances of winning the much coveted trophy.

First of all, let us consider the Curtiss monoplane. Here is a machine which is every inch a racer. The pilot's seat is far in the rear part of the body, as will be noted in the accompanying illustration. In fact, it is two-thirds of the distance from the nose to the tail. The monoplane is provided with a short and stubby propeller with stream-lined hub or "pot." The wing is very thick, and is braced on each side of the body by a single thick strut slanting down to the hub of the landing wheel. The radiator is arranged on either side of the body as shown, so as to reduce the head resistance to a minimum. The engine is a twelve-cylinder Curtiss type, developing 400 horse-power.



The Curtiss monoplane racer, equipped with 400-horse-power engine. Note the position of the cockpit, two-thirds the distance back from nose to tail. Also note the radiator on the sides, so as to reduce head resistance

TABLOID HISTORY OF THE GORDON BENNETT CUP CONTESTS

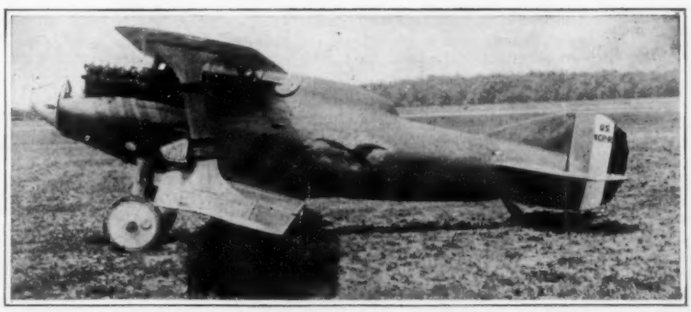
1909—Glenn H. Curtiss (American), winner. Race held at Rheims, France. Speed attained, 43 miles an hour. Curtiss biplane, 50-horse-power.

1910—Grahame-White (British), winner. Race held at Belmont Park, Long Island, U. S. A. Speed attained, 61 miles an hour. Bleriot monoplane, 100-horse-power.

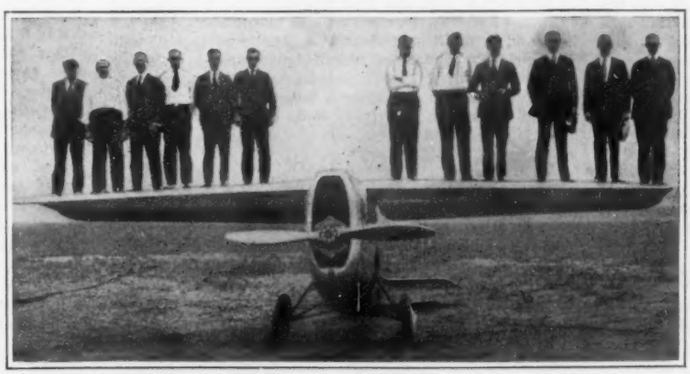
1911—C. T. Weymann (American), winner. Race held at Isle of Sheppy, Eastchurch, England. Speed attained, 78.1 miles an hour. Nieuport monoplane, 70-horse-power.

1912—Jules Vedrines (French), winner. Race held at Clearing, Illinois, U. S. A. Speed attained, 105 miles an hour. Deperdussin monoplane, 160-horse-power.

1913—M. Prevost (French), winner. Race held in France. Speed attained, 126.59 miles an hour. Deperdussin monoplane, 200-horse-power.



The Verville-Packard biplane, equipped with 500-horse-power engine. Unlike the Curtiss monoplane, the pilot here is pretty well shut in. This machine has the latest Packard engine which develops unusual power



The Dayton-Wright monoplane, equipped with 250-horse-power engine. The wings are rigid cantilever structure, made up of three-ply veneer. The landing gear can be pocketed on either side of the body

The Army Air Service is known as the Verville-Packard and is of all-American design and manufacture throughout. It was designed and built by the Packard Motor Car Company under the guidance of Col. J. G. Vincent, who also designed the engine. [A complete description of the 500-horse-power engine installed in this plane was described in our issue of September 4th, 1920, on page 226.] The engine has a total piston displacement of over 2,000 cubic inches and weighs approximately 1.94 pounds per horse-power, representing a distinct forward step in aircraft power plants.

The Verville plane was designed and constructed especially for this engine, but it is, however, in no way a freak racing machine. It is built for both service and production. The plane itself has been developed by the engineers of the office of the Chief of Air Service at the Engineering Division at McCook Field. It is felt by the Army men that in the face of the terrific speeds which will undoubtedly be shown by all planes entered in this year's event, the Army Air Service has an excellent chance to win. Captain Rudolph Schroeder, present holder of the world's altitude record, will pilot the Army plane.

The Dayton-Wright monoplane measures only 22½ feet from wing tip to wing tip. Its body is 12 feet long. The wings are of rigid cantilever construction. Instead of being covered with fabric, they are made of three-ply veneer. When the little machine is in flight the wheels and the entire landing gear are drawn up inside the body and the machine presents the appearance of a gigantic steel projectile darting through space at more than three miles a minute.

It is this retractible chassis, or landing gear, wing structure, and what is known as a variable camber or wing curve that make the Dayton-Wright a remarkable contestant for world speed honors. While technical details have necessarily been withheld, pending the race, it is known that a crank in the instrument board of the machine enables the pilot, after he has left the ground, to raise the wheels and landing frame into the fuselage, and at the same time using the same mechanism, automatically to flatten out the wing. The whole process requires only from 12 to 15 seconds. It requires even less time to drop the wheels and restore the wing curve in landing.

The curve in an airplane wing affects the speed at which the machine takes off or lands, but it also retards or accelerates its speed while in the air. For instance, the curve of the wing enables it to take off more quickly and land at slower speed, thus requiring a smaller field and eliminating danger in landing in an emergency. By evolving a means whereby the wing curvature can be altered at will, the Dayton-Wright designers have been able to decrease the landing speed to twenty miles an hour, and increase the racing speed in the same ratio.

By drawing up the landing gear and

(Continued on page 266)

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

Radium in Medicine

IF purchases can be taken as an indication, it would seem that medical men are approaching unanimity of opinion with reference to the use of radium, which at one time was held to be without value by at least one important group. Recent purchases of $120,000 worth of the rare element by medical men in a single month indicate the tendency and emphasize the necessity of conservation.

It is estimated that there have been between 105 and 110 grams of radium recovered from the ore thus far, of which 70 grams were from American ores. The European reserve stocks were practically exhausted for war purposes, being used principally for luminous dials and elsewhere in forms which mean its absolute loss to science. There are probably between 20 and 22 grams in the United States at the present time, part of which is that owned by the Bureau of Mines and loaned for medicinal purposes. The necessity for conservation becomes more evident when it is understood that the ore bearing the radium occurs in pockets, that the surface pockets have been practically exhausted, and that future supplies must come for the most part from those pockets which can be located by drilling. It is evident that this carries a considerable degree of uncertainty and while authorities differ as to the amount of radium that will possibly be recovered from now on, conservative estimators place it at a total of 100 grams.

American Analytical Balances

A CONSIDERABLE percentage of the demand for analytical balances is for the type which has a definite sensitivity of one-tenth of a milligram under the full load of 200 grams in each pan. This type of balance has been successfully made by American methods, which means quantity production. One of the well-known manufacturers believed he could effect certain improvements if it were possible for him to obtain orders justifying new jigs and tools, and an order for 1,000 from a single progressive dealer was sufficient to guarantee the new work. An order for so many analytical balances of one type was something new in scientific apparatus of this character, but the result has been a moderately priced balance which meets the requirements of industrial chemists and many of the educational institutions.

Tin Recovery

THE recovery of tin from scrap has engaged the attention of several chemists, especially since the demand for the tetrachloride of tin has been increased by the rapid growth of the use of silk. A new process has just been patented in which the scrap tin is first treated with a strong solution of sodium hydroxide at from 120° to 150°F. in an iron tank lined with graphite or some other material electro-negative to tin. The galvanic action set up between the graphite and the tin accelerates the solution of the tin, and the operation is repeated with various batches of scrap until the bath is rich in tin. The solution is then placed in a second iron tank and bales of scrap tin are suspended in the bath and a current passed. The tank acts as the cathode and the tin becomes the anode. In this process the tin from the bale is dissolved and deposited, while the tin is also deposited from the bath itself, so that it can be returned to the first tank and re-used.

Graphite from Kish

THE story of how artificial graphite produced from anthracite or petroleum coke by electrolytic methods employing Niagara power has gradually replaced natural graphite, is well known. Natural graphite has held its place principally in the manufacture of large crucibles, but recently patents have been issued covering methods of manufacturing crucibles in which artificial graphite is an important ingredient. The output of artificial graphite has risen very rapidly, and from 1915, when it reached five million pounds, it increased to ten million pounds by 1918. Much of it finds its way into lubricants, paints, battery fillers, foundry facings, and boiler scale preventatives.

Attention has recently been called to the possibility of recovering graphite from the mixture of that substance with slag, iron oxide, fragments of iron, etc., which accumulate about a bessemer or open-hearth furnace or casting ladle, and known as *kish*. The graphite is formed during cooling by the crystallization of the excess carbon from the molten iron, and the graphite, which may reach 8-10 per cent, is in the form of light, thin flakes. If the mixture containing the graphite is carefully screened and treated with magnetic separators, the graphite may be concentrated and refined. The supply is probably not great enough to present a commercial possibility at the present time, but may form a worth-while source in the future.

Flotation Applied to Fuel

THE experiments which have led to the perfection of the Trent process for the treatment of coal illustrate again the success which often attends the application of processes peculiar to one field to the problems in another. Certain types of coal carry their ash in a form sufficiently segregated to make it possible to separate it by ore flotation methods. This removes about eighty per cent of the ash and gives an oil-coal fuel possessing desirable characteristics. If advantageous, the oil could be recovered. One of the best features of the process is the possibility of reducing the coal to a fineness sufficient to pass a 200-mesh sieve by wet grinding methods, thus eliminating one of the principal hazards in the use of powdered coal, namely, the liability to spontaneous explosion of the very fine dry carbon dust.

Experimental Coal Mines

DR. J. J. RUTLEDGE presented an argument in favor of demonstration coal mines before the American Institute of Mining and Metallurgical Engineers at their February meeting, urging the importance of such mines if the most is to be made of the technical skill that can be employed in solving the problems of underground coal mining. Some of the experiments which could be tried are: Satisfactory methods of stopping the slacking of mine roofs during the summer; determining the best method of mining in a particular field; developing better methods of timbering; a study of proper explosives; mining machines; methods of haulage; ventilation; generation and distribution of power; efficient pumping; greater safety in shot-firing; and a testing of the roof or bottom shale in metallurgical plants or in the manufacture of brick or terra cotta ware.

Carbon

THE work on special charcoals for gas absorption in gas warfare defense has brought to many a better appreciation of the differences in charcoal and other forms of carbon. The field offers a wonderful opportunity for research of the most profitable kind, when the usefulness of carbon for clarifying and decolorizing is fully considered.

Lately a number of laboratories have undertaken the problem, their work differing in the raw materials as well as in method. Rice hulls, kelp, and lignite are some of the raw materials used. The premium which we pay because we have not been sufficiently interested in developing suitable decolorizing carbons is illustrated by the fact that one foreign company has met with much success in first licensing the use of their carbon at $5,000, then selling the material at $500 per ton, and in addition receiving a royalty of thirty cents for each 100 pounds of material decolorized with this secretly prepared carbon. A number of concerns use the material even under these conditions, and the prize should be enough to attract some of our best physical chemists.

Motor Spirit

THE *Journal of Commerce* reports a new process for the extraction of commercial alcohol which, though still in the experimental stage, is said to be capable of producing a satisfactory motor spirit. The work has been carried on in England, where alcohol and derivatives have been recovered from coke oven gas by a sulfuric acid contact process. An average yield of 1.6 gallons of alcohol per ton of coal carbonized is reported and it is calculated that if all of the coke oven gas from the coal reduced to coke in England during 1918 had been subjected to this process, more than 23 million gallons of alcohol would have been recovered.

Non-Coking Coals

EXPERIMENTS conducted at the University of Illinois on low temperature carbonizing of coal have been reported to the American Institute of Mining and Metallurgical Engineers, and while the work has really but begun, the indications are that the so-called non-coking coals of Illinois may be advanced one of these days into the class of coking coals. Working at 750°C., the gas produced was high in calorific value and the tars were of unusual interest.

Methanol

IT has been pointed out before that in view of the importance of wood alcohol to the chemical industries, the legislation which might be enacted as the result of its use as a beverage became a subject for serious consideration. In the belief that the names wood alcohol and methyl alcohol were partly to blame, a change has now been agreed upon so that hereafter this article of commerce will be known as methanol.

Aircraft Dope

FOR some time "dopes" made from cellulose acetate have had the preference for coating fabric used in aircraft production. It is more expensive than materials composed of cellulose nitrate since in their manufacture acetic acid and acetic anhydride are required and these raw materials are more expensive than those employed in the nitration of cellulose. However, the acetate is fire resistant or slow burning and that has given it a decided advantage. It has now been found that some five to eight per cent of ammonium magnesium sulfate when added to the nitrate makes it fire resistant, since when ignited a quantity of ammonia gas is given off extinguishing the flame.

Furfural

FURFURAL is another of those substances upon which comparatively little industrial work has been done because of its scarcity and price, which made it out of the question for manufacturing purposes. Few industries could afford to pay $17 a pound for raw material. In attempting to use a part of our annual crop of corn cobs, it has been found that furfural is one of the materials that can be prepared, either as the principal product or as a by-product, and costs as low as ten cents per pound have been realized. At the Bureau of Chemistry it has been found that furfural may become the starting point for a large number of dyes which may become as important as one of the series now obtained from coal tar products. It may be condensed and, experimentally, a fast brown dye has been made by treatment with sodium sulfide for wool and silk, and with ammonium sulfide for the direct dyeing of cotton. The stimulation of such valuable research is sure to follow from the establishment of our organic chemical industries, but without encouraging legislation this will be impossible and development which often produces values in unexpected places will be stifled.

Carbon Black

CARBON black is a fluffy, velvety pigment, usually produced by burning natural gas with a smoky flame against a metal surface and the product is entirely different from lamp black, with which it is sometimes confused. Lamp black is gray in comparison with carbon black and in all places where carbon black is used lamp black is practically an unsatisfactory substitute. In normal times we have been in the habit of exporting about 15,000,000 pounds and besides this have used in printers' ink ten to twelve million, rubber goods, twenty million; stove polish, four to five million; and miscellaneous, one million pounds annually.

The Bureau of Mines has undertaken an investigation of probable sources of lamp black and with the gradual lessening of our natural gas supply the question of carbon black may become a rather serious one. The present methods are known to recover but a few per cent of the carbon in the gas, and developmental work on efficient methods of production from natural gas and other possible materials is in order. The thermal decomposition of gas or other hydrocarbons with insufficient supply of air, or explosion with carbon monoxide, carbon dioxide, oxygen or their mixtures has been suggested.

Left: Making a feast from a half-rotten potato. *Center:* View, a little over half size, showing clearly the mantle and breathing pore and the two pairs of horns or tentacles, with the eyes in the tips of the longer pair. *Right:* Stuffing himself with the foliage of the chrysanthemum

Some close-up views of the garden slug, with special reference to his major occupation of eating

A Queer Visitor in the Garden

By Hamilton M. Laing

HIS book name is Ariolimax columbianus, but he is better known as just plain "big slug." He *is* a big slug—almost unbelievably big when first we meet him. He attains a length of seven and a half inches and a thickness greater than that of a man's thumb—a veritable leviathan of his kind. When we meet him stretched out on his way across a woods path or find him clinging to vegetation far from the ground, he is like something seen only in the nightmares of a small boy.

In general appearance this slug is like a huge snail minus his shell. Instead of a shell on his back he carries merely a mantle and his single breathing pore is through the right side of this mantle. His eyes are perhaps his most peculiar feature: he has a double set of "horns" or tentacles, the front pair short, the hind pair much longer and in the tip of this rearward pair are his eyes. He can "pull in his horns" in very truth and the eye comes too—periscope and feeler in one. Also, each tentacle works independently of the other. His color is tawny green and his back usually is more or less mottled with brownish—just the combination to hide his slow-creeping form from prying eyes that might be peering about in the shadows of the moss-green woods.

A most interesting thing about him is his manner of getting over the ground. When extended and on the march his body seems magically to slip forward; we have to look closely to mark his steady progress; the slime trail behind him is best evidence. Though he has no legs he does not wriggle forward like a snake. His under surface really is his "foot" and he is glued to the ground, this flat member sticking tight and secreting the slime that marks his path. He moves forward in sections. His head and foreparts extend momentarily and after them in a series of minute ripples come the more rearward segments. In this way he can climb any obstacle from the spiny bark of the devil's club to the surface of a pane of glass. Timed and measured on a woods path he has been found to make two and one-half inches in two minutes or six feet three inches in an hour. Yet the scientists say that this slow-going chap came to Oregon and California from Asia, by way of Alaska; and that he walked!

The slimy trail glittering in the morning sun upon the cement walk or on the earth in the garden is the unfailing sign that Ariolimax has left the woods and come for a visit. When he is traveling extensively the amount of this mucilage he has to manufacture is considerable. Why he does not become permanently glued down with his own adhesive is one of Nature's mysteries; for when the mixture is taken between the fingers and worked half dry it has the stickiness of commercial glue. Doubtless one reason for the slug's dislike for the sun is that he is in danger of being dried up and cemented down.

Usually one of the interesting things about a creature is its food and it is over the food question that this big slug comes into closest touch with man. He comes out of the woods and into the garden for a purpose. His appetite is tremendous and there is little that he will not devour from a whole row of new lettuce to the top sprays of the tall chrysanthemums. What he eats seems to depend on circumstances; for when his expedition lands him on the lawn he accepts

(*Continued on page 268*)

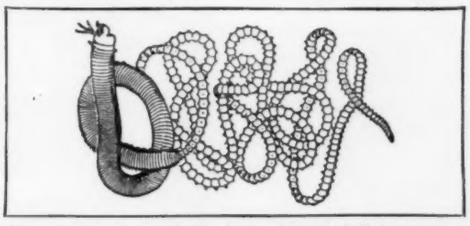
Ships for Sheep

THANKS to that Western ingenuity which has so frequently overcome extreme obstacles, a three-decked barge has been devised for transporting sheep from winter to summer pasturage on the Chelan National Forest, Washington. The time element in moving 3,000 head of sheep has been reduced from 15 days to 15 or 20 hours.

Big barge for moving sheep from winter to summer grazing grounds

The accessibility of Lake Chelan, 3 miles wide and 50 miles long, renders practicable the use of a barge in hauling the livestock. Formerly, the sheep were driven overland from the winter to summer grazing territory, the tedious journey of 15 days through rugged mountainous areas proving disastrous to many of the lambs.

A gasoline boat propels the three-decked equipment, which was specially designed for the purpose. About 1,000 sheep are carried on each trip, the expense being 12 cents for each head. The barge is a connecting link between summer and winter pasturage, the sheep leaving the winter range country in the spring only to return when the leaves again assume a tint of hue in the fall. The lake itself is at an elevation of 1,800 feet above sea level, and is a dividing line between varying areas as to climatic conditions conducive to luxuriant pasturage.—By *S. R. Winters.*



The palolo worm of the South Pacific, showing the rear portion that breaks off

A moat designed to protect garden plants from slugs

Headless Worms—A South Sea Delicacy

EVERY year in October and November enormous swarms of the so-called "palolo" worms suddenly appear on the day before the last quarter of the moon along the coasts of the South Sea Islands. The natives await this event with keen interest, since they highly esteem these worms as a delicate tit-bit whether eaten raw or roasted. It is said, too, that Europeans who have succeeded in "acquiring" a taste for them find them very palatable and appetizing. It has long been noted that these creatures were always headless and this circumstance has now been explained, says a writer in *Kosmos* (Stuttgart), by the fact that the palolo worm is really only half a worm! In other words it is the rear portion of the body of an annular worm, the *Eunice viridis*, which finds its habitat in the crevices of coral reefs. This curious creature has its body divided into two sharply defined portions, as shown in the accompanying illustration. The essential part of the animal is the upper portion of the body, consisting of thick broad "rings," while the lower portion or "tail" is composed of much smaller annular segments. This part of the body, which may reach a length of 50 cm., is devoted to reproductive purposes. At the period of sexual maturity this section of the worm, which is filled with sexual products, breaks away from the main portion of the body and rises to the surface of the water, where it swims about for a time and then gradually separates into its segments, which discharge their contents into the water, thus fulfilling their function. Meanwhile the parent animal peacefully leads its obscure existence in the rifts of the coral reef and proceeds to grow another "tail." This is a typical example of the self-crippling capacity so often seen in the animal kingdom, and shows what an important biological function this peculiar power may serve. In this case, of course, the principal purpose is the extension of the territory in which the worm exists, since the lightness of the rear portion of the body enables it to float far and wide from the place of its origin.—By *M. Tevis.*

Novel Plant Protection

IN the case of a rock garden, which contained a number of valuable Alpine plants, much trouble was experienced from slugs. Some important specimens were badly damaged by the pests and all ordinary means of keeping the enemies at bay were without avail. A plan which met the difficulty is pictured.

All around the garden a ditch was opened up. This was about 9 inches in depth and 7 inches in width. Strips of sheet zinc 20 inches wide were then secured. These were bent around in a U shape. The ditch was lined with cement and the zinc trough placed in position as shown, with the cracks cemented over so that the whole arrangement was water-tight.

When the garden was completely encircled with the zinc trough water was poured in. In this way the rock garden was completely cut off from the surrounding area. For a few days a thorough search for slugs was maintained among the Alpine plants. When all these had been destroyed there was no further trouble with the pests seeing that none of the creatures was able to cross the water barrier.—By *S. L. Bastin.*

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

This device brings the emergency brake lever fully 6 inches nearer the driver's hand

Bringing the Emergency Brake Within Reach

A NEW device introduced by a Los Angeles firm brings the emergency brake handle within reach of the driver without the tiresome groping and stretching for the iron handle.

The device trips the ratchet of the emergency brake by means of a release which operates with the same movement of the hand that sends the lever backward or forward. The ball grip is easily grasped and the lever is, in reality, brought six inches nearer the operator's hand by using the device.

Radio Banking Service

IT is reported that wireless banking is a success aboard the ex-German liner "Imperator." The Cunarder has established the first sea bank with a safe large enough to carry a huge amount of cash. Drafts on shore banks are honored and the money transferred by radio.

A Camp Grate That Folds

WHEN this camp grate is folded it is only four inches wide and twelve inches long, with a weight of five pounds. When it opens it has a cooking surface of 36 inches, and will support three large cooking utensils.

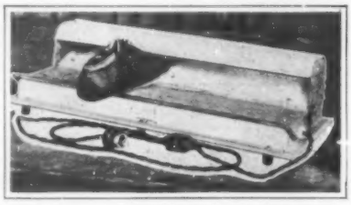
This camp grate can be folded into a small bundle 4 inches wide and 12 inches long

Reclaiming the Barren Land

IN order to reduce the scarcity of food on the one hand and to increase the land available for settlement on the other, the German Government has suddenly turned its attention to the reclamation of barren lands. The area of barren land yet to be found in Prussia alone is estimated at not less than 3,705,000 acres. Between 1850 and 1918 approximately 1,970,000 acres were brought under cultivation. A further 3,705,000 acres of rich soil is yet to be obtained by drainage.

A Stove That Softens Shoe Toes

THIS is one of the improved electrical devices used in the shoe business. It will not burn leather, yet it softens the toes and speeds up production. The shoe is placed right side up with toe of last under the shelf. An adjustable rod on top holds back the vamp keeping the box toe flat on the slab. Heat is regulated by a thumb switch. It is not necessary for current to be turned on continuously as when the asbestos slab is hot it will retain heat for some time without current. It requires but a very few minutes to soften the shoe toe so that it can be lasted by hand or on a machine.



The toes of shoes are softened in this small electric stove

The Tilting Table Saw

AS the term "tilting table saw" implies, the force of gravity is capitalized in chopping wood by pivoting the table to the lower portion of the frame and so constructing that when a cut is finished the downward tug will pull the table from the saw and into position for moving the wood up for the succeeding cutting performance. The design is especially adapted to cutting cordwood or short chunks—frequently phrased as "stovewood length."

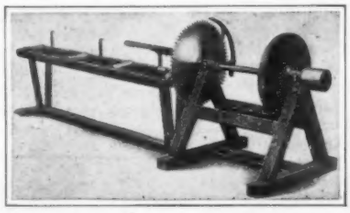
When designed exclusively for cutting cordwood, the table is constructed immediately in front of the saw mandrel, the uncut portion of the wood passing between the flywheel and the saw blade. The severed chunk then can fall directly to the ground, eliminating itself for the succeeding cut. The saw mandrel is less than 4 feet in length; and if the flywheel is stationed on the saw mandrel, poles or other lengthy pieces of wood cannot be placed on the table without coming into contact with the flywheel.

Consequently, tilting-table frames designed for chopping pole wood are of a varying construction. The flywheel is mounted on another shaft, permitting its operation below the table, or the latter is stationed on the side of the saw blade away from the mandrel. Such an arrangement permits of the wood being fed to the saw from the outside.

A New Wheel Guard for Railroads

A NUMBER of men prominent in railroad circles and other men who preside over safety departments, got together in a northern Ohio town not long since to witness actual tests of the new guard which is attached to the front end of cars and extends to within a few inches of the rails. All tests were made with a dummy, weighing as near as possible the average weight of men employed as brakemen, switchmen and in other railroad capacities. In all tests, at which time the dummy was placed in positions resulting from falls from moving trains, the guard cleared the track of the obstacle, and in only one was it injured. This was in a case in which the dummy sat upon the tracks, and was passed under the train between the wheels, uninjured with the exception of having its overalls torn and scratched.

The guard itself is a forged bar of steel curved to conform to the shape of a car wheel. The upper end is T-shaped which provides means for bolting it to the carbolts of the underframe. The lower end holds a slipper. Normally this balances, but when an object is forced against it, it drops to the track and clears off any obstruction. It will not only be the means of saving lives of railroad men, but will prevent train wrecks caused by obstacles falling across the tracks. A large railroad tie was placed in such a position, and as it came in contact with the guard it was thrown aside and the train of several cars passed in absolute safety.

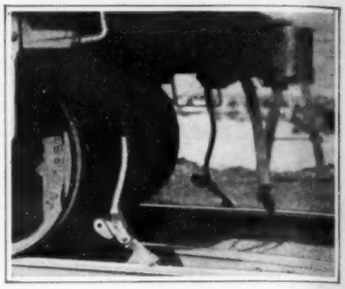


A tilting saw table which simplifies and speeds up sawing

Saving the Heat That Goes Up the Chimney

IT is a well-known fact that with the fuels at our present and past disposal we are, as we have been, highly extravagant. So far as the consumer is concerned, to be sure, this extravagance is often involuntary, being attributable to furnace, stove and oven design that makes impossible the full utilization of the heat produced. In particular it is quite usual to have the gases that pass off up the chimney carry with them several hundred degrees of heat, which has not been utilized in any way.

In the effort to use to the full the heating power of the conventional briquettes, a German manufacturer has placed on the market a briquette stove constructed on a new plan. The stove in question takes briquettes of brown coal or turf, and will likewise burn artificial fuel of various sorts, made from coal and coke tailings, etc. It is claimed that three briquettes will heat a room of moderate size. It is in some use as a sort of preliminary warming medium for rooms in which the temperature is later to be maintained by



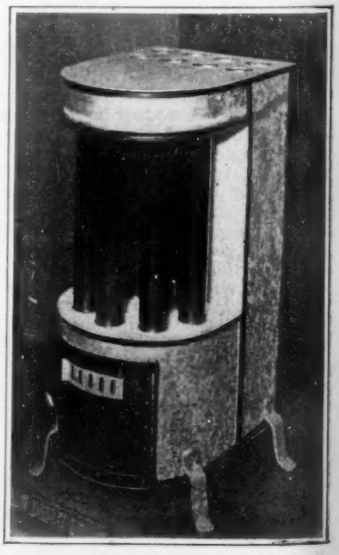
These simple wheel guards are attached to railroad cars for safety's sake

the rather more economical but not nearly so effective tile stove which has for so long been the bane of travelers in Germany.

The trick of this stove is the passing of the gases of combustion through the several heating chambers before they go to the chimney. They are allowed to retain only so much of their heat as is necessary to insure a good draft. Utilization of the heat heretofore carried off by these gases is effected through a quantity of tubes, arranged vertically in the chamber, and affording the necessary absorbing and radiating surface. The tubes are open above and below, and the gases pass freely through them and to the chimney. Effective radiation of the heat is assured by the exposure of the surface of these tubes to the room atmosphere, as indicated in our illustration.

Canada and Carbide

THE manufacture of calcium carbide at various points throughout the Province of British Columbia is being strongly advocated these days. This material, which is manufactured from limestone and coke by subjection to heat in an electric furnace, is used for the production of acetylene gas, as a substitute for gasoline, and for certain chemical purposes. One ton of calcium carbide is obtained from 3,000 pounds of the mixed material.



German stove with unusually large radiating surface

The Farm Electrical—
bigger crops, greater comforts

WHAT farmer has not dreamed of the day when he would no longer be "the man with the hoe." And to many farmers, the day of realization is already here.

The electric power line is reaching the most remote districts and with it a new science, a new system and a better, more prosperous life for those who produce life's necessities.

Thousands of acres of arid, unproductive land have been reclaimed and made to yield glorious harvests, through irrigation with electric motors and pumps. Tilling, planting, harvesting, threshing, ensilage, cutting and storing of grain may be done quickly with less work and greater profits for all concerned.

"Chores" which get the average farmer up early and keep him up late, may be motorized at little expense. Today, the water is pumped, the cows milked, the butter churned, the milk separated, the tools kept sharp—all by electrically driven appliances.

And the farmer's wife? With electricity as her housemaid, life is worth living. Cleaning, washing, cooking and sewing are done at the touch of a button. When evening comes there is the MAZDA Lamp and comfort, for electricity has done the day's work and will do tomorrow's.

To make the electrical machinery which generates and transmits this force, to study its application in the form of light, heat and power and to make it available for the betterment of all mankind, is the endeavor of the General Electric Company, exemplified in a service which has extended over a quarter of a century.

95-107

GENERAL ELECTRIC COMPANY

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

AIRCRAFT HAVING INHERENT STABILITY.—J. A. FLEMING, 10 W. 65th St., New York, N. Y. The primary object of the invention is to provide an aircraft having a novel arrangement of surfaces and structure, making it inherently safe. Another object is to obtain longitudinal and lateral stability and to prevent sideslipping. Another object is to obtain the maximum of lift, and a low forward center of gravity by disposing of the greatest weight to the forward end of the body of the aircraft.

Electrical Devices

FLASH LIGHT TESTING APPARATUS.—G. A. LEY, 3912 No. Seeley Ave., Chicago, Ill. The invention relates to flashlight photography and the testing of apparatus for use in connection therewith. An object is to provide a lamp box and lamp for testing the electric circuit connection which is to be used in blowing a fuse and igniting the flash powder; the device may be used with a battery in which case a battery box is provided with the lamp box or with the ordinary city current.

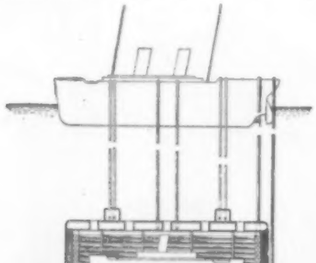
Of Interest to Farmers

WAGON LOADER.—G. HAISS, 141st St. and Rider Ave., Bronx, N. Y. This invention has for an object to provide a device which is automatic in its operation. A further object is to provide a device in which the operation is continuous so long as there is any material to be operated upon. A further object is to provide a machine particularly adapted to operate upon piled material, and means for feeding the piled material laterally.

APPARATUS FOR HANDLING RACKS.—F. J. LOVERING, Octavia, Neb. This invention has for its object to provide a device especially adapted for placing and removing hay racks and wagon bodies from the running gears of wagons, wherein a wheel supported standard is provided, having means for lifting the rack or body one end at a time and placing it on the running gear, the wheels and the rack having means for preventing skidding movement during the lifting of the load.

Of General Interest

APPARATUS FOR RAISING SHIPS.—W. F. GRUMME, 203 W. 103rd St., New York, N. Y. A hollow pontoon is provided by this invention which is adapted to be towed to and lowered over a sunken vessel. The pontoon is



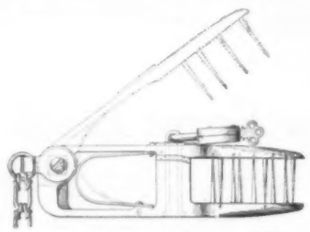
SHIP SALVAGING APPARATUS

provided with refrigerating means whereby the water enclosed within it may be frozen into a solid block of ice. When this is done the buoyancy of the ice brings the block, with the ship it contains, to the surface.

ROSETTE FOR BRIDLES AND OTHER PARTS OF HARNESS.—H. L. DAUGHERTY, Box 607, Carson City, Nevada. The object of the invention is to simplify and cheapen the construction of harness parts at the same time making them durable and attractive. The rosette comprises a hollow body having an inner flat wall provided with a transverse slot, and with a keeper adjacent the slot, a latch bar having a slidable connection with the keeper and having an angular portion adapted to enter the slot to engage the inner face of the flat wall and hold the latch bar in place.

SIGHT FOR FIREARMS.—J. E. KRAFT, Groveland, Cal. One of the principal objects of the invention is to provide a sight representing such a color to the marksman that it will contrast with the object aimed at. A further object is to provide a sight whose visual surface will be disposed at such an angle to the gun barrel that it will be always properly illuminated, irrespective of the angle at which the light falls on the sight.

ROBE SECURING DEVICE.—R. REID, 15 Jackson St., Sanford, Me. The invention pertains more particularly to robe clamps, and to devices of this character especially adapted



A SIDE ELEVATION OF THE CLAMP, DOTTED LINES SHOWING OPEN POSITION

for use in connection with vehicles. The primary object is to provide means by which a lap robe may be left in an automobile without danger of its being stolen therefrom.

CLASP.—L. B. HOCHSTEIN, 22 North St., Endicott, N. Y. The primary object is to provide a casp of the pivoted type especially adapted for retaining the open ends of a box or pasteboard carton in close relation. A further object is to provide a device which will be fint when in its operative position, and which may be entirely removed when in its inoperative position.

TOWEL CABINET.—E. J. SHAUGHNESSY, c/o F. O. Hendrick, 137 Greenwood Ave., E. Orange, N. J. An object of the invention is to provide a support for a continuous towel strip which facilitates the use of the strip. A further object is to provide a towel cabinet which will be economical in that the portions of the towel which are in use are maintained in a smooth condition, and the dirty or soiled portions are maintained out of contact with the clean, fresh portions thereof.

SETTLING TANK.—S. F. KELLER, Thebodaux, La. The invention has for its object to provide a tank of the continuous operating type for the clarification or separation of sugar cane juice or the like, after the juice has been treated with sulphur dioxide and neutralized with calcium hydrate, wherein the juice follows the natural trend of liquid that has been heated.

AMMONIA DISSOLVING COMPOSITION FOR USE IN REFRIGERATION APPARATUS.—C. DELAYGUE, Paris, France. An object of this invention is to provide a refrigerating composition which will dissolve large quantities of ammonia under high pressure with a resulting small volume. Another object is to provide a refrigerating composition which may be freed of ammonia by heating without giving off other volatile substances which would interfere with the refrigeration process. The composition consists of ammonium nitrate 3 grams, trimethylamin 2 grams, liquid ammonia 554 cubic centimeters, and sufficient water to make one liter.

Hardware and Tools

LOCK.—L. E. CANTRELL, address L. M. Gibson, Maxwell House, Nashville, Tenn. The invention relates particularly to "pay-as-you-enter" locks which allow a person to enter a door on depositing the required coin. A money register is embodied within the lock to count the number of coins deposited and also the number of entrances through the door.

TOOL FOR REPLACING SUCKER RODS.—E. B. HATCH, Box 175, Turley, Okla. The invention relates to a tool for use in replacing sucker rods in oil wells. The object is to provide a tool by the use of which the dangerous operation of lifting the rods off of the elevator will be done away with, and which will make it impossible for rods to get away from the brakeman by proving a check for the rods in case the line should break, which will prevent the rods from falling farther than the tubing nipple.

Heating and Lighting

COMBUSTION DEVICE.—S. YOUNG, Yquitos, Peru. The object of this invention is to provide mechanism of the character specified for permitting the utilization of fuel in the form of shavings, paper, straw, slack and the like, and for insuring the complete combustion of the same, and for conserving all the heat generated during combustion.

Machines and Mechanical Devices

CRIMPING MACHINE.—E. T. REUTER and W. A. SKINNER, 366 Pearl St., Manchester, N. H. An object of ths invention is to provide mounting and operating mechanism for a pair of form plates instead of one which doubles the capacity of the machine over the Legge machine and which facilitates the employment of guards to protect the operator. With this device one of the plates is always descending so that double production is possible.

Medical Devices

TRUSS.—G. H. EDDLEMAN, c/o J. Edington, Baltimore Bldg., Memphis, Tenn. The object of this invention is to provide an arrangement whereby the truss when once adjusted and placed in proper position may be permanently worn and all necessity for its removal, for instance in the bath, may be eliminated. A further object is to provide for various adjustments by which the pad may be properly and comfortably seated and thereafter locked in the desired position, permitting of free body movement.

Musical Devices

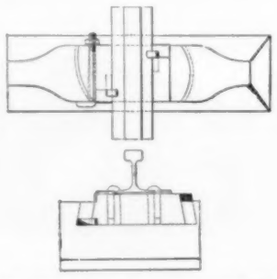
PHONOGRAPH NEEDLE.—J. HEINO, 1178 Washington Ave., New York, N. Y. This invention pertains to a phonograph needle which may be used any number of times, but in which the actual playing point is not of sufficient hardness to damage the record. A further object is the provision of a needle which shall incorporate means for holding the playing point so firmly that it is impossible that any slipping of the same might occur, but which nevertheless is capable of being instantly loosened and removed without the help of any mechanical skill.

Prime Movers and Their Accessories

ROTARY ENGINE.—S. E. KOCHENDARFER, 58 N. Main St., Washington, Pa. This is an improvement on a prior application (Serial No. 164,436) which disclosed a rotary engine having L-shaped pistons. When the rotor was revolving fast there was a tendency for the piston to jump past the intake port and in certain positions to swing inwardly permitting escape of steam. These tendencies are overcome by an improved construction disclosed in the present patent.

Railways and Their Accessories

CROSSTIE.—J. R. DOOLEY, 7 So. Springhill Ave., Mobile, Ala. The prime object of the invention is to provide a cross tie whereby rails may be supported and mounted thereon, and although the rail mounting may become defective on account of wear it will not be



A PLAN VIEW AND SIDE ELEVATION OF THE INVENTION

necessary to replace a cross tie, the construction being such as to enable the removable rail supporting section or block to be used, which may be removed from the cross tie and replaced in a practical manner. Another patent has been granted to the same inventor, the prime objects of which are to provide means for securing railway rails to the ties and for securing the meeting ends of the tie sections together.

LATERAL TAKE-UP DEVICE FOR LOCOMOTIVE AXLES.—H. B. FURSTONBURG, 1801 Park Ave., Shreveport, La. The present invention is an improvement on the inventor's previous patent (No. 1,202,701) which showed inner and outer take-up sections adjacent to each of the driving boxes, the inner sections being keyed to the axle and the two sections having abutting flanges. In the present invention collars are substituted for the inner sections and the flanges as well.

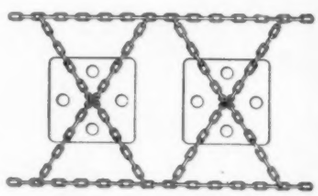
Pertaining to Recreation

TOY AIRPLANE.—P. O. ROTH, 28 Pullis Ave., Middle Village, N. Y. A toy airplane of simple and comparatively cheap construction is provided by this invention. The toy is intended to fly a short distance through the air when thrown or projected by pressure from the rear. It is of strong construction and will maintain a substantially straight course on an even keel.

RACE GAME APPARATUS.—R. M. BRENNER, P. O. Box 151, Palisade, N. J. This is an improvement on the constructions described in patents No. 1,011,562 and No. 1,203,474, previously granted to Mr. Brenner. In the present invention each actuating device controlled by a player is rendered inoperative as soon as the racing figure reaches the goal. The construction insures winning of the race by the operator who exercises the most skill rather than speed.

Pertaining to Vehicles

ANTI-SKID CHAIN.—E. BENJESTORF, Fenwood, Saskatchewan, Can. In connection with tire chains for the wheels of motor vehicles the inventor provides relatively flat plates



ANTI-SKID TREAD PLATE FOR TIRES

with lugs or projections which serve to prevent skidding of the vehicle. Owing to the fact that short lengths of chain pass between the lugs the possibility of clogging of the lugs with mud is removed.

ATTACHMENT FOR MOTOR VEHICLES.—D. L. STROUD, R.F.D. No. 2, Box 13, Mabel, Minn. The object of the invention is to provide an attachment adapted to support the rear wheels of a motor vehicle out of contact with the ground, to permit them to rotate freely to drive machinery of any character, and wherein means is provided on the attachment for permitting the rear end of the vehicle to be quickly and easily lifted on to the attachment to support the wheels for running freely.

HYDRAULIC JACK.—A. PAOLI, Hancock, Mich. The invention has for its object to provide a jack, small and compact of form, and especially adapted for use with motor vehicles, wherein a cylinder is provided having a base and a hollow piston movable in the cylinder and having movable therein another piston to which the saddle is connected, together with means for moving the hollow piston downward, to provide for a large amount of lift with small amount of controlling movement and without the use of valves or the like.

Designs

DESIGN FOR A LAPEL RIBBON.—A. TILT, 51 E. 79th St., New York, N. Y.

DESIGN FOR A PIN, BADGE, FLAG OR SIMILAR ARTICLE.—C. A. HOWARD, 9 Maiden Lane, New York, N. Y.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject-matter involved, or of the specialized, technical or scientific knowledge required therefor.

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SKF *Research Laboratories established at Philadelphia to co-operate with the big Gothenburg Laboratories in the study of the American Manufacturers' friction problems.*

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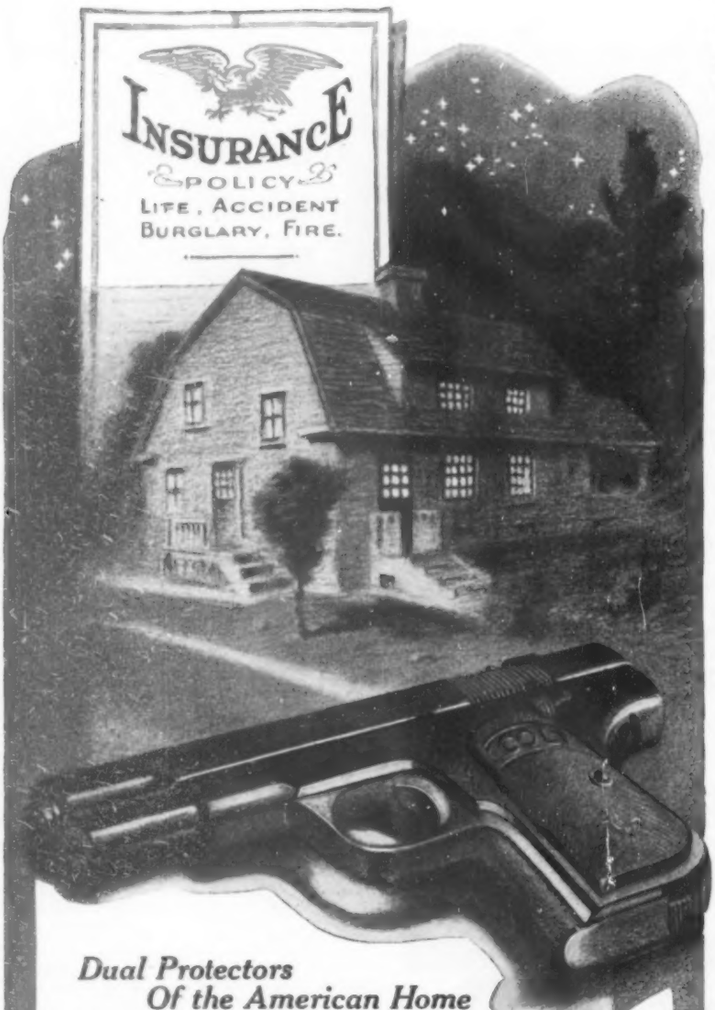

Dual Protectors Of the American Home

WHAT home would be without the beneficent insurance policy which restores and repairs after loss and damage? Without insurance those catastrophes, beyond the power of individuals to prevent, would be complete. And we companion this insurance with the protection of a COLT to thwart harmful and evil influences which, unless prevented, lead to catastrophe.

Thus—the stealthy shadow of the auto thief, seen from your bedroom window at your garage door, vanishes into the night when you challenge him with a COLT.

The sneaking figure of the fire-bug who, with vengeance in his heart for a fancied wrong, means to make a ruin of your home or factory when surprised, surrenders when confronted with a COLT.

The night prowler caught upon your veranda has no other thought but flight, instead of the savage rush he premeditated, when he comes face to face with a COLT.

Instead of battling the futile resistance of empty hands, the bold hold-up man who has stopped your car on the lonely highway becomes a shrinking coward when he finds you argue with a COLT!

And so we have the dual protectors of American homes, the insurance policy which provides a recompense for those losses which could not be helped, and a COLT Automatic Pistol or COLT Revolver which reduces to a minimum the unpreventable danger.

When you buy a COLT remember that you are getting "The Best that Money can Buy." Nothing else should satisfy.

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FIRE ARMS
"The Best that Money Can Buy"

Splitting Hairs With Close-Limit Tools

(Continued from page 243)

it is considered that 20 degrees Fahrenheit difference in temperature will change the length of an inch block by more than twice the margin to which the close grinding is held. The heat of the hands and the heat of the machines make so much difference that the work is checked on the indicator gages between successive grinding operations.

The final few molecules are caressed off the blocks by the die-making group, who get and assemble the parts. By a series of gentle rubbings against flat cast-iron blocks, they finally bring the various sections to so nearly the same size that it is necessary to split an inch into millionths to find out which is which. The slots in the blocks that hold the die sections, the punch sections and the shedder sections must be made to almost exact dimensions, and must have their sides absolutely parallel with each other, and absolutely perpendicular to the surface of the blocks.

Then there is the little question of "locating holes" and "locating pins," which must be accurate to about half a medium heavy shadow, and a lot of other close work that requires more patience than answering questions in an orphan asylum.

It is possible to work to even closer dimensions than the hundred-thousandth of an inch limit on the most particular class of tools, but it very rarely is done. For instance, there are two firms, one in this country, and one in Sweden, that make standard blocks of various lengths which they guarantee to be of exact size to within a few millionths of an inch. Either firm will, upon special order, furnish blocks within one millionth of an inch variation from true size. The check measurements on the blocks produced in this country are made by optical methods, using the wave length of light as the final measure, as has already been told in these columns.

The Greatest of Floating Cranes

(Continued from page 247)

tional facts now before us it will readily be understood perhaps that the operation of transferring a big 250-ton gun mounting would run through substantially the following series of movements. The crane stands up about as erect as it can and swings around on its roller bearings until it has the gun mounting before it. The load is secured and lifted by operating the tackle connected with the rear hoisting blocks. There are two independent blocks, each capable of a lift of 125 tons. But there is a special block with which they may be interconnected, the whole combination being able to deal as a unit with the 250-ton load. The crane now rotates once more on its roller bearing until it faces the location where the mounting is to be deposited. It then extends its reach by flattening the angle of the jib. When the load is above its destination, the steel tackle is again operated and the mounting deposited.

The arm or "neck" with which the crane reaches outward and withdraws inward is the longer part of a single unit. The shorter part is another arm set at an angle of perhaps 135° with the longer part, the whole forming a bent boom. The whole is a rigid unit. It is pivoted at the bottom of the short part. It has but a single movement up and down in a vertical plane. The lifting and lowering of the load is or may be done ordinarily with one of the block-and-tackle devices without any movement of the bent boom. The boom itself is elevated and depressed with or without the load, the point at which it is stepped being the center of its radial movement in its vertical plane. This depression and elevation of the boom is accomplished by one of the most interesting features of the whole affair. Back of the boom is a triangular rocking beam. One vertex is hinged to a central framework at a level about half-way between the foot of the boom and its elbow. Another vertex is linked to the elbow, while the third—farther to the rear of the boom—is linked to the vertical cross-head of the elevating device. The cross-head shifts up and down in a vertical plane, these movements being accompanied by a lowering and elevating of the jib. Double plate girders provide for the guidance of the cross-head. The shifting of the cross-head between its guides is accomplished by two remarkable screws. These are each 60 feet in length and 13½ inches in diameter. By means of powerful machinery the great screws are simultaneously turned and the boom with whatever weight may be upon it raised or lowered.

Crane Lighter No. 4 is so weighted by the disposition of its machinery, a certain amount of dead weight ballast, etc., that when there is no load on the crane and its boom has been elevated to the limit and has its minimum reach in an athwartships direction, the vessel heels over 4 degrees and has its deck depressed on the side back of the elbow. When the boom is depressed to the 100-foot radius for the inner blocks and a load of 250 tons is on the hook, the vessel heels the same amount but naturally in the opposite direction. No shifting ballast is employed. The crane has actually been tested with a load of 312 tons.

Hydraulic brakes are employed with some precision in controlling the movements when the great load is on. Steam brakes are also used.

The two floating cranes at Panama—the *Hercules* and the *Ajax*—are duplicates of each other. The pontoon measures, roughly, 150 feet in length and 89 in width. When the jib is withdrawn to its innermost position, its tip is about 206 feet above the deck. There is under the operator's cab a counterweight of 150 tons. A second counterweight three times as heavy is in the after part of the pontoon and a third on the cross-head. All movements are effected through electrical means.

Malaria Control

MALARIAL control through the application of anti-mosquito agencies re-emphasizes the dictum that an ounce of effort at their breeding places is more effectual than gallons of immunizing fluids after the pesky insect has once obtained a lease on life. Recognizing the necessity of making warfare on polluted streams and other breeding sources of the mosquito, the U. S. Public Health Service has conducted a series of intensive experiments in an effort of controlling production of the germ-laden pest.

Among the unusual control methods adopted in the prevention of the hatching of mosquito larvæ is the spraying of streams with kerosene or a heavy black oil, classified by dealers as a grade immediately below fuel oil. The application is made with knapsack pump sprayers or by means of automatic drip cans. Of course, the expensiveness of the oil is a factor to reckon with, but one small Southern lumbering town made effective its control operations at an aggregate cost of $2,506.40, or a per capita cost of $1.23½. Moreover, the visits of the physicians for the purpose of treating malaria were reduced 70.39 per cent compared with the previous year. The permanency of control methods would undoubtedly curtail the operating expenses in making warfare on the mosquito.

The novel departure of applying the oil by means of a drip can be proved practical by the utilization of small platforms, stationed over the streams, from which cans were suspended. These stands were built of scrub-oak saplings or odds and ends of timber assembled from the lumber mills. Spaced 200 yards apart, the drip cups were so designed as to deliver drops of oil from an elevation

(Continued on page 262)

Where Lincoln Cars are Leland-Built

In one of America's most modern factories, here Lincoln Cars are Leland-built.

Originally planned for the production of that marvelous mechanism — the Liberty Aircraft Motor — here produced in largest volume in the shortest time, that wonder work-shop turns to peace-time occupation.

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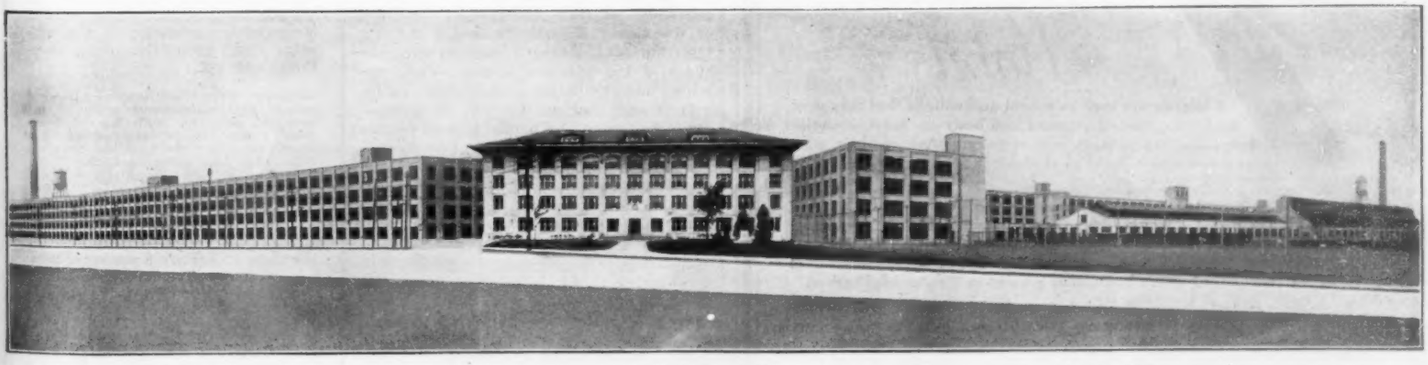

Looking Northeast *Administration Building* *Looking Northwest*

Composite View of Lincoln Motor Company's Main Plant in Detroit

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L. E. Waterman Company
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Chicago Boston San Francisco

Malaria Control

(Continued from page 260)

of 4 feet to swiftly moving portions of the creek or stream. As the can absorbed the warmth of the day, it was so regulated as to permit of the delivery of 15 drops of oil a minute.

By the drip-can outlet, 1,035 gallons of oil were distributed on old ditches, 70 gallons applied to new ditches, and 258 gallons used in exterminating the mosquito larvæ along street ditches. The 50 drip cans used represented an expenditure of $39, while the cost of constructing the drip-can stands was calculated to be $9. There were two knap-sack sprayers purchased at an outlay of $14.79, and labor and spraying in the operation of control methods were estimated to be $238.69.

Water Pipes of Wood

(Continued from page 250)

coating. Such a coating may be a paint or it may be a disinfectant. It is said that coatings are useful with fir and pine. With redwood the case is not so clear. A mixture of tar and asphaltum is considered excellent for the pine and fir; but redwood has done so well without the protection of a coating that the matter remains in doubt as to this material.

Wood stave pipe is held together by steel bands or hoops placed at frequent intervals. There are two problems here. One concerns itself with the strength of band required to resist the bursting pressure of the contained water. This will naturally vary with the head and with the size of the intervals between bands. The second problem centers on the tendency of the tightened band to sink into the wood. The size of the band, the spacing interval and the bursting pressure—all play their part here. For almost any given pipe line there will be two or three sizes of band permissible, but the spacing for the different sizes will naturally vary also. A representative band is a round rod with a button at one end and, say, 5 inches of thread at the other. A fitting, called a *shoe*, is employed to cinch the ends of a band together. These vary somewhat in design. It is considered important that the shoe should be stronger in the body than the band itself, as thus it is possible to develop the full strength of the rod. A case has occurred, it seems, where the shoe was weaker than the band, and in consequence somewhere about 390 tons of steel were wasted.

The staves make butt joints with the stave ahead and the one to the rear. Naturally, these butt joints are distributed so as not to have an undue number at any one point of cross-section. In order to prevent leakage at these joints, the following precaution is taken. A steel or iron strip, perhaps ¼ inch thick, called a *tongue*, is arranged to lie half in one stave end and half in the other. Slots are provided to receive the tongue. The width of the tongue will be, say, 1½ inches. Its length is a little greater than the width of the staves at the locations of the slots. This extra length permits insertion of the tongue ends in the side edges of the adjacent staves. They are coated over with an asphalt base paint.

It is said that, in the case of redwood pipe, the life of the bands determines the life of the pipe. It is accordingly important to prolong the life of these hoops and their shoes, and therefore to use the proper coating at the outset. A paint with an asphaltum base is considered a proper one. Now and then a band will have to be replaced; but generally speaking its life is understood to be greater than that of steel pipe. A reason for this has been given. The band, being round, exposes an inconsiderable surface to the weather. Red lead is considered a very good coating material, indeed. Galvanizing is a method of protection that is costly; but it appears to be the only thing employed in the Hawaiian Islands in connection with redwood.

Instead of the continuous wood stave

(Continued on page 264)

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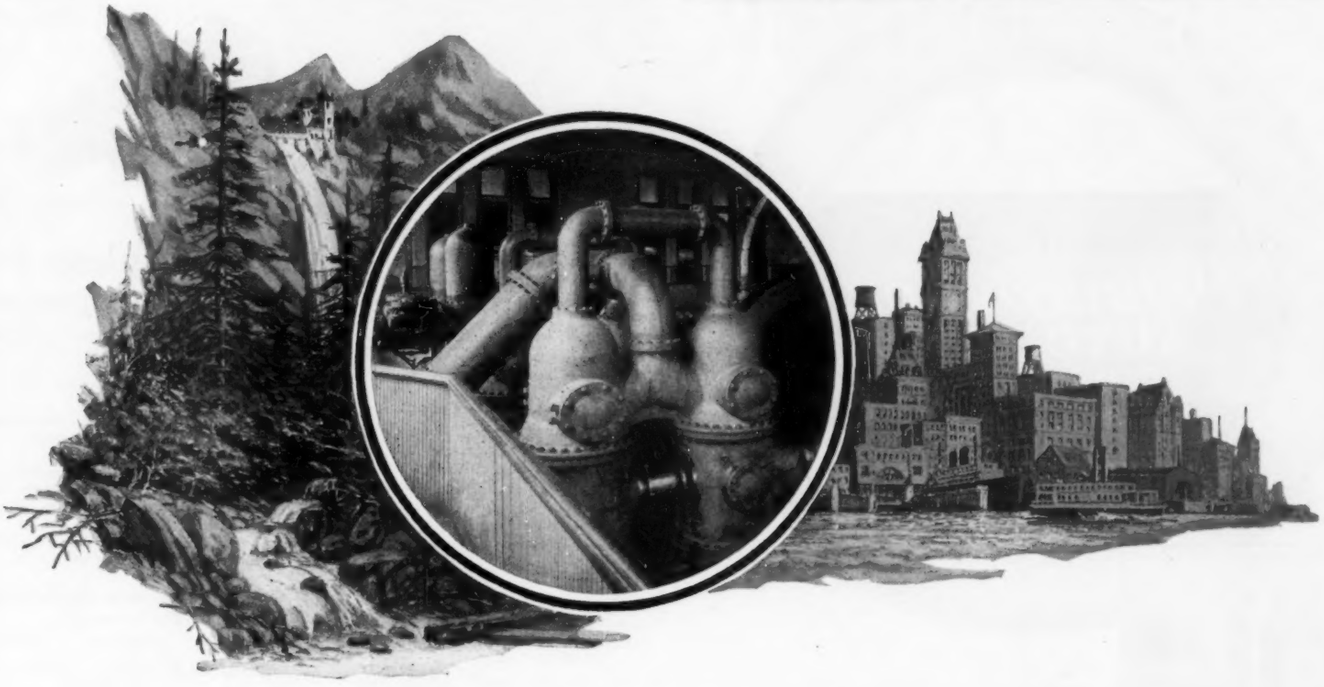

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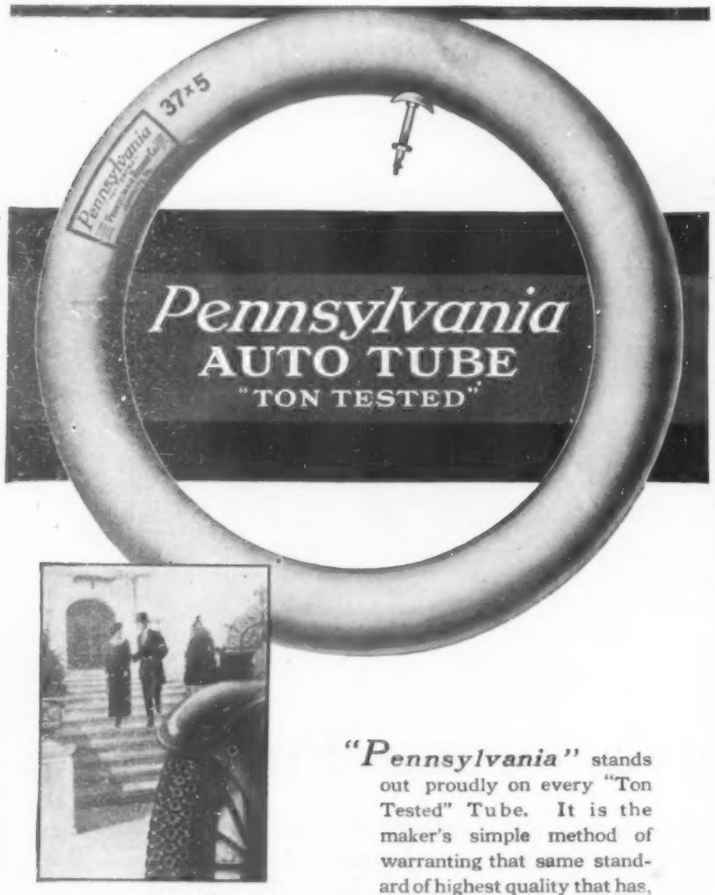

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Water Pipes of Wood

(Continued from page 262)

pipe, the whole of whose erection is carried out in the field, one may substitute short lengths of machine-made wood stave pipe. That is, machine-banded or wire-wound pipe may be employed. Such piping may be obtained in diameters ranging up to 24 inches, inside diameter. The lengths run from 8 to 24 feet, and are provided with the collars and couplings necessary to their secure junction in the field. Such pipe is understood to be made for heads running up to 400 feet. The band, or wire, is secured to the pipe by means of pressed-steel clips or staples or both. The sections, once banded, are dipped in melted asphalt and then rolled in sawdust. The asphalt affords protection, the sawdust makes it possible to handle the pipe.

Some of the more important installations of continuous wood stave pipe are the following: At Atlantic City, N. J., a 48-inch line, 5 miles long has been laid across the salt marshes where metal pipe lines have failed. A big piece of wood piping is the line laid for the Erie Construction Co. (a subsidiary of the Ontario Power Co. of Niagara Falls). The whole line is about 1½ miles long. The shorter half consists of 144-inch pipe and the longer half of 132-inch. Pretty big tubing. The maximum head in contemplation was 150 feet. But there is a mile of continuous wood stave pipe which forms part of a big hydroelectric development on the White Salmon River and which has the magnificent diameter of 162 inches. Some pipe! It is carried on wooden cradles 4½ feet apart, center to center. The weight of the contained water is nearly 900 pounds per linear foot of pipe.

Checking Up the Gas Meter

(Continued from page 252)

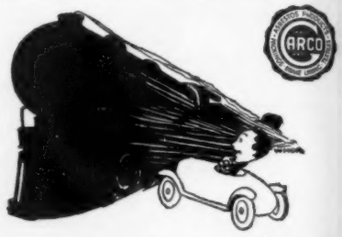
the building. On large yellow oblong sheets of paper the meter's "pedigree" is entered—the size, the manufacturer, the premises it came from with the date, the number of years it was in service, the number of previous tests, and the date of each test. Beside the spaces for these entries there is a column in which is printed a series of indices similar to the clock faces of a meter, and hands are drawn on the diagrams to correspond to these on the meter under observation.

In the initial testing operation the meter, attached to the prover, is under conditions exactly the same as when in the home. In this first operation the "U" shaped water gage shows whether any gas is escaping from the meter box. Care must be exercised in attaching the hose. Sometimes three minutes are necessary to adjust it to the satisfaction of the tester.

After this preliminary test the meters are opened to see how much repairing is needed. Their condition determines whether they fall into the classification of light, medium, or full repairs. On the tenth floor a force of men puts in the parts which the previous inspection showed were needed. Upon the completion of repairs and a test of the meter for soundness, a high pressure test is made.

Sometimes a leak is not detected by the "U" gage. When this happens the meter case is filled with water. No matter how small the hole, it is soon discovered. After soldering, another test is made for soundness. Ordinary meters have 50,000 cubic feet of air passed through them to detect any defects, like a loose cog or a buckle at any point. In the operation several meters are linked up together, with a connection to a master meter. After this test there is a final one made with the provers before the meters are sent to what is called in the building the State Department—a space on the ninth floor, on the east side of the premises, where inspectors of the Public Service Commission are at work.

(Continued on page 266)



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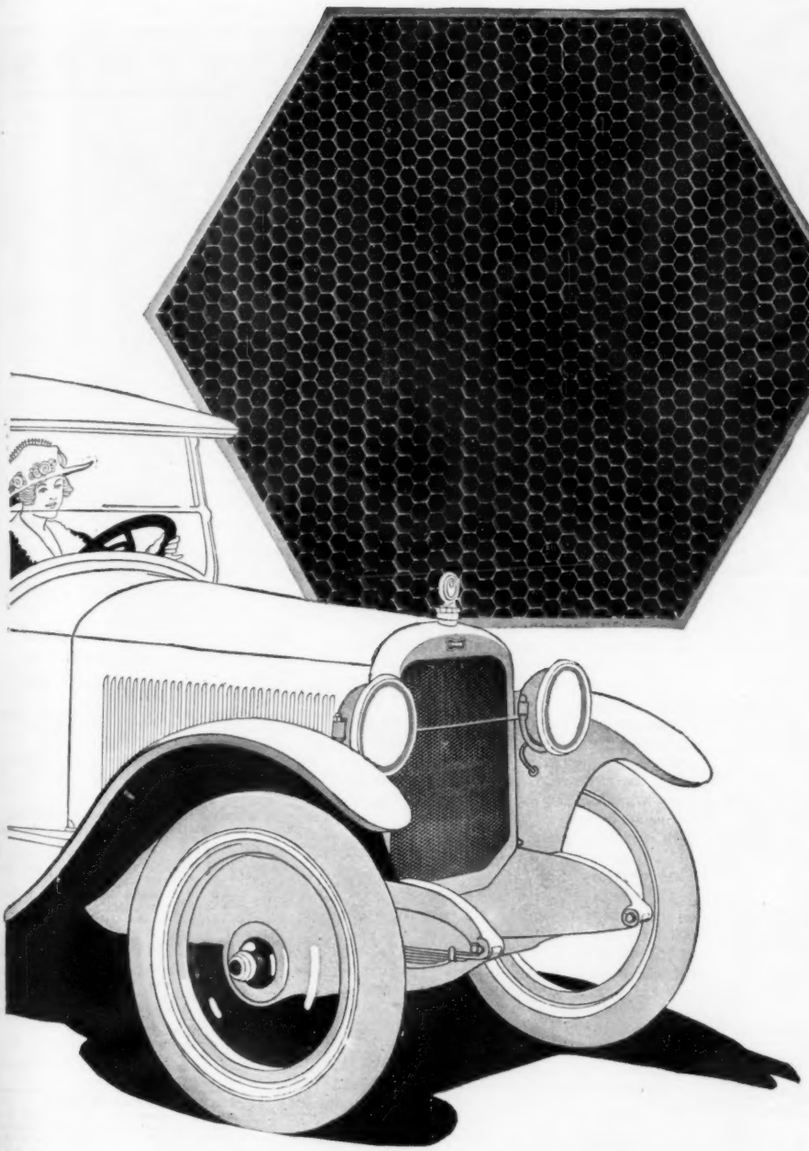

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Checking Up the Gas Meter

(Continued from page 264)

Here there are twelve proving machines identical in design with the ones used by the company. The inspectors, after verifying the company's tests, apply the seal of the commission at the top of each meter, near the upper edge of the index. So strict are the regulations as to the use of the seal that inspectors are under instructions to carry their sealing irons home with them at the end of the day's work.

On this floor the meters are painted and placed in bays, according to the ownership of the various gas companies throughout the city. On this same floor the prepayment or slot meters are tested.

An important part of the testing operations is the examination of the diaphragms. These are made of Australian sheep leather—found by experience to be the best material for this purpose—and are attached to the metal disks in the measuring chambers. Generally speaking, the disks and diaphragms constitute a kind of double bellows. The quantity of gas used is measured by the number of times they fill and empty—consequently they must not leak in the slightest degree.

Quality of leather and the exercise of all possible care in the manufacture of the diaphragms cannot prevent mishaps to them now and then. In severe weather a meter will sometimes freeze, which destroys the leather. It turns white and gets hard. All diaphragms are examined by an expert with a view to learning the extent of the repairs that might be necessary. In the majority of cases the leather only needs softening. This is accomplished by giving it a bath in Pennsylvania mineral oil heated to a temperature of 110 degrees Fahrenheit.

All new meters are tested for accuracy on the ninth floor. Great care is exercised in the adjustment of the tangent in the valve chamber. The tangent bears the same relation to the testing mechanism as a pendulum to a clock. Hence it must be adjusted to a nicety, if the meter is to meet the requirements set by the Public Service Commission, which, it may be added, guarantees the reliability of all meters upon which is has placed its seal after a test for accuracy.

America's Bid for the Gordon Bennett Cup

(Continued from page 253)

thus lessening wind resistance, they have added 25 miles an hour to 125 miles an hour speed of the monoplane, and from 30 to 35 miles an hour while it is racing at 175 miles an hour or more with flattened wings.

The body of this very remarkable plane is of monocoque construction. In other words, it is made of thin strips of wood bound tightly with fabric strips laid in glue, the strips criss-crossing the under layer each time that a layer of wood is applied. The pilot sits inside the machine completely enclosed by the doors which open on either side just back of the point where the wings cross the top of the body as though laid over it.

The machine is powered with a special Hall-Scott racing engine of the Liberty Six 250-horse-power type, made by the Hall-Scott Motor Car Company of Berkeley, Cal. Although the Dayton-Wright monoplane will probably be the lightest powered entry in the Gordon Bennett race, its designers hope that the relative power and speed achieved will enable it to outfly heavier competitors. The efficiency of the motor is to be further increased by using a special synthentic fuel developed in the Dayton-Wright laboratories.

This unique monoplane will be flown in the races by Howard M. Rinehart, who with Milton C. Baumann, designed it. The plane is known as the "R-B," derived from Rinehart-Baumann.

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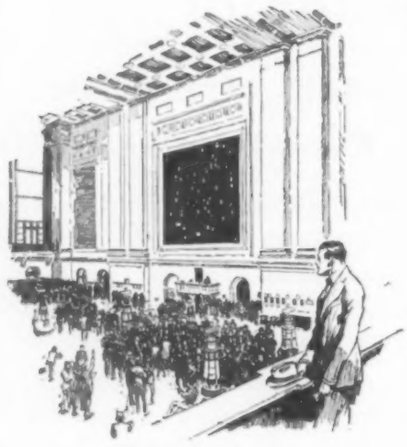

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A Queer Visitor in the Garden

(*Continued from page 255*)

the dandelions; when he reaches the vegetable garden even the rhubarb leaves disappear; and when he lands among the flowers he is equally impartial.

Yet though he is a gormand he is not nearly so destructive as the legions of his tiny brothers, the garden slugs. Ariollmax is big and easily found, easily kept away. Lime or salt is fatal to him. When he encounters either he perishes miserably, the salt especially making a dreadful mess of him: he disintegrates. A sprinkling of dry lime around a flower or vegetable bed usually will protect it except in wet weather. Even dry sand makes a fairly effective barrier, difficult for the invader to cross.

Though not much of the life history of this creature is shown in the garden, something additional is disclosed in the woods. The young are met early in the spring and doubtless the eggs are laid by the adult among the leaves and protective debris of the forest floor. When first hatched the young are like the parent but very small; but they grow rapidly and by the end of May they are about an inch in length. They are colored like the adults but are shorter and thicker in proportion to their length. Their mission in life seems to be merely to eat and grow, and they do both tremendously, arriving shortly at the size of their leviathan parent; and when the rains of autumn trickle through the firs they are ready for a six-foot-an-hour pilgrimage into the garden.

NEW BOOKS, ETC.

BATTLEFIELDS OF THE MARNE. 1914. Milltown, N. J.: Michelin Tire Co., 1920. 8vo.; 292 pp.; illustrated; maps and plans.

Combining a history and a tourists' guide, this handbook transforms a tour into a pilgrimage, and makes the very ruins tell their absorbing stories. The fine finish of paper used brings out well the strikingly artistic effect of the hundreds of illustrations. Following practical information that will greatly further the convenience and comfort of the traveler, a tour is outlined for the Ourcq, the marshes of Saint-Gond, and the pass of Revigny. The plans and maps are skilfully drawn and colored.

THE STANDARD ELECTRICAL DICTIONARY. By T. O'Conor Sloane, A.M., E.M., Ph.D. Addition by A. E. Watson. New York: The Norman W. Henley Publishing Company, 1920. 8vo.; 767 pp.; illustrated.

In its 1920 edition, this well-known reference work carries a substantial supplement containing the very latest developments of electrical science. There are 6,000 terms briefly defined; but the definition is immediately followed by a popularly-worded explanation that may run to several hundred words. These little articles are further amplified by hundreds of cuts and diagrams, the whole constituting an encyclopedic exposition of modern theory, experimentation and engineering.

YPRES AND THE BATTLES OF YPRES. Milltown, N. J.: Michelin Tire Co., 1920. 8vo.; 139 pp.; illustrated; maps and plans.

Ypres, dominated by low hills, was the theater for some hot work during the war. Succeeding situations are here diagrammatically outlined for us. We find a clear account of the first and second battles, the allied offensive of 1917 in its six phases, and the German attacks of 1918. The material, richly illustrated, is so arranged as to make easy a two-day visit to the town and the salient, and covers all features of interest.

VERDUN AND THE BATTLES FOR ITS POSSESSION. Milltown, N. J.: Michelin Tire Co., 1920. 8vo.; 112 pp.; illustrated; maps and plans.

Verdun took some of the mightiest hammerstrokes of the German army. The battles for its possession may be understandingly followed by means of the plans of the great offensives given in this guide. Our own soldiers helped to clear Verdun, and a noteworthy picture is the panoramic view of the battlefield as seen from a German observation post. There is a good plan of the city, many scenes from its streets, and folding maps that show fine detail.

RHEIMS AND THE BATTLES FOR ITS POSSESSION. Milltown, N. J.: Michelin Tire Co., 1920. 8vo.; 176 pp.; illustrated; maps and plans.

The bombardment of Rheims and the wanton wrecking of its imposing cathedral form one of the most unforgetable chapters of the war. After seeing the plans and pictures of this excellent guide, we seem to have been actually over the ground. Both the student of the war and the tourist will find this a work well worth possessing.

LILLE BEFORE AND DURING THE WAR. Milltown, N. J.: Michelin Tire Co., 1920. 8vo.; 64 pp.; illustrated; maps and plans.

Lille, another old historic town, has a page devoted to its history. How it fell in 1914 and how it was delivered after a four years' occupation is told in maps and text. The town is covered in four itineraries with very exact directions to the tourist, aided by plans and embellished by pictures of buildings, monuments, and works of art.

SOISSONS BEFORE AND DURING THE WAR. Milltown, N. J.: Michelin Tire Co., 1920. 8vo.; 64 pp.; illustrated; maps and plans.

This guide follows the same admirable arrangement of others in the series, giving first the chief historical events and a descriptive summary, followed by the incidents of the German occupations and evacuations and the life of the place during the thirty months' siege. The traveler is conducted to and through the cathedral, through the badly-damaged quarters of the town, by ruined churches, and finally to the surrounding scenes of desolation left in the wake of battle.

AMERICAN GUIDE BOOK TO FRANCE AND ITS BATTLEFIELDS. By E. B. Garey, U.S.A., O. O. Ellis, U.S.A., and R. V. D. Magoffin, Ph.D. New York: The Macmillan Company, 1920. 8vo.; 331 pp.; illustrated; maps.

As Major General Leonard Wood says in his foreword, "The names of the authors guarantee not only its practical value as a traveler's guide, but its dependability in matters of civil and military history." The book avoids the interminable detail of the ordinary guide, for various and good reasons: but it answers most questions on the mechanics of travel, sketches the terrain of the war with especial reference to American participation, and furnishes facts and figures in common demand. Our soldiers and their friends will find the account of operations and the Division Histories of the greatest interest. The pictures and folding maps deserve a specific word of praise.

THE DESIGN OF ALTERNATING CURRENT MACHINERY. By James R. Barr, A.M. I.E.E. and R. D. Archibald, B.Sc. New York: Isaac Pitman and Sons. 8vo.; 496 pp.; 340 illustrations; 17 folding plates.

This substantial work, a companion volume to Barr's "Direct Current Electrical Engineering," first considers complex wave forms and harmonic analysis; transformers, alternators and converters receive a very full treatment; mechanical features, insulation, efficiencies, tests and losses are dealt with from a practical point of view and, in addition to ample illustration throughout the text, there are sixteen folding plates that ably reveal the construction of the various devices.

AUTOMOBILE BATTERY CARE AND REPAIR. By Harold P. Manly. Chicago: Frederick J. Drake and Company, 1920. 16mo.; 335 pp.; illustrated.

Wherever starting, lighting and ignition repairs are made or storage batteries handled, whether in the shop or the public or private garage, this compact handbook will prove its worth. It is a manual for the workman whose aim is to turn out satisfactory work without lost motion or wasted time: it makes him intimately acquainted with the lead-acid battery and operating conditions, with charging equipment, and with the best method of test and repair.

FORESTS, WOODS AND TREES IN RELATION TO HYGIENE. By Augustine Henry, M.A., F.L.S., M.R.I.A. New York: E. P. Dutton and Company. 8vo.; 314 pp.; illustrated.

The economist, engineer and physician, to say nothing of the general reader, are insufficiently informed regarding the influence of trees on climate, water flow, soil erosion, and the purity of air and water. While this work is specifically concerned with reforestation in Great Britain, the information and general principles are largely applicable to our own needs, and should benefit American readers. Among other branches of the subject it takes up sanatoria sites, town parks, and conditions affecting the planting of water catchment areas.

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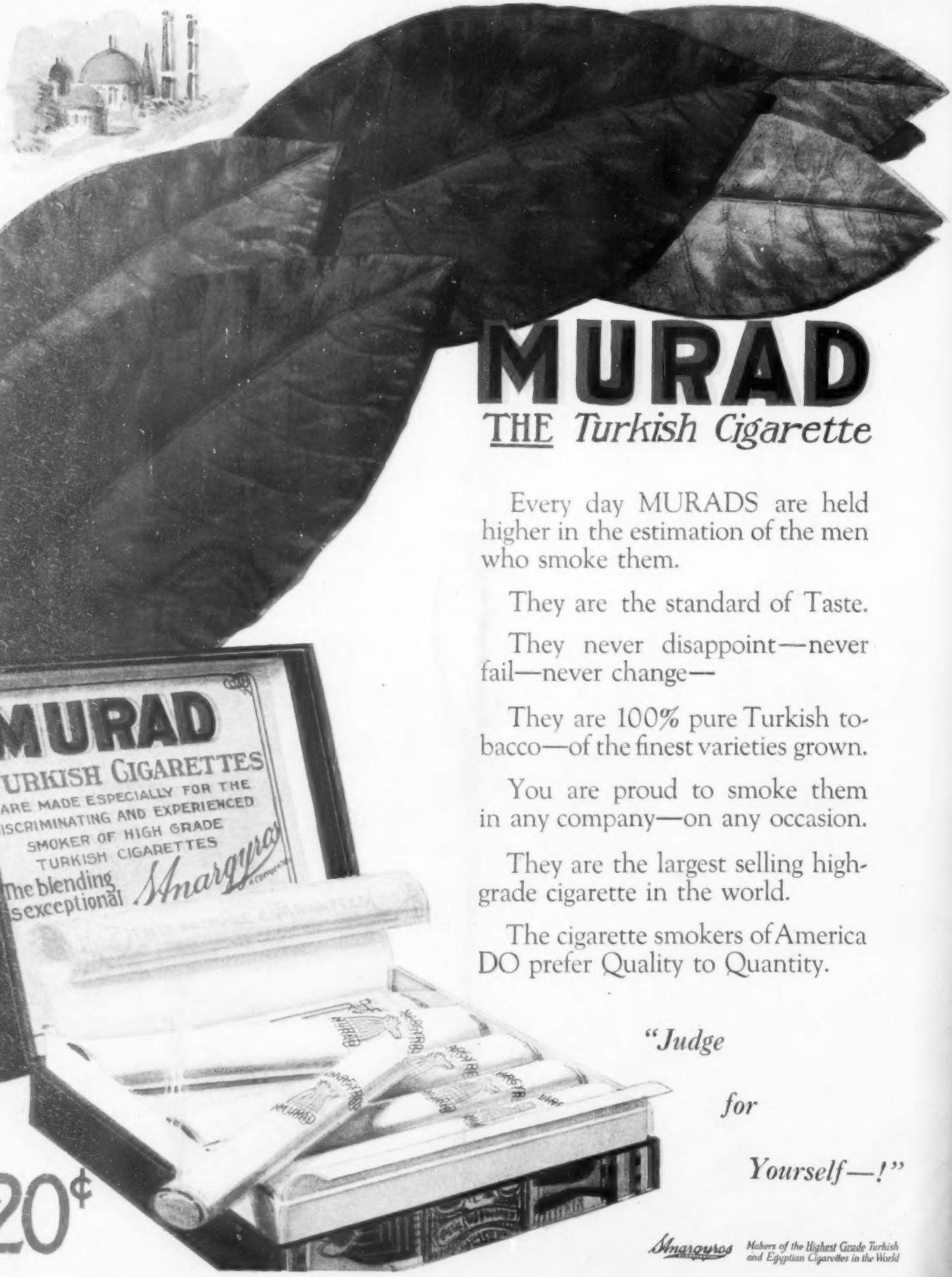

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